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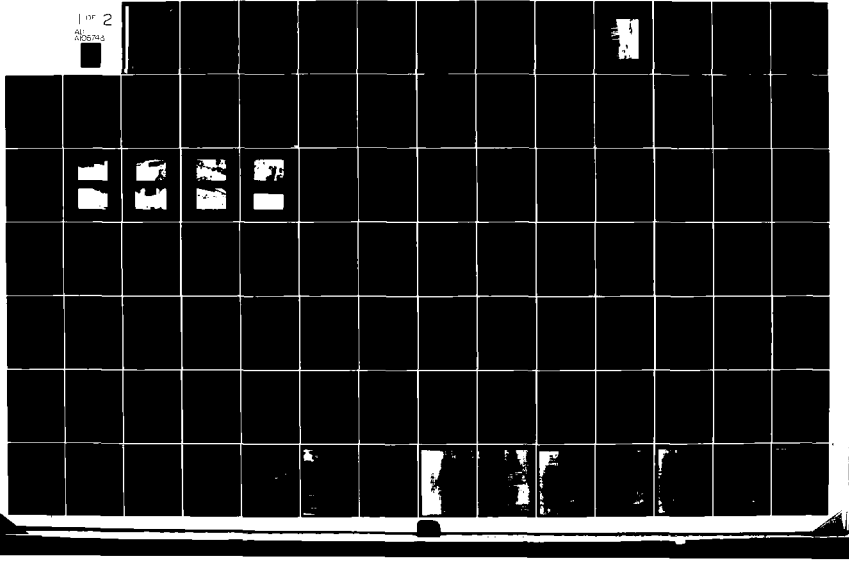
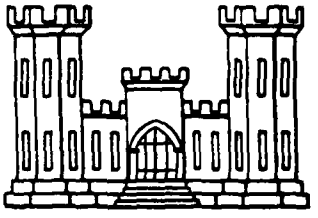


LOWER HUDSON RIVER BASIN

EARL RESERVOIR DAM

ORANGE COUNTY, NEW YORK
INVENTORY NO. N.Y. 203

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

JUNE 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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9. PERFORMING ORGANIZATION NAME AND ADDRESS Michael Baker, Jr. Inc. 4301 Dutch Ridge Road Box 280 Beaver, PA 15009 (16) Granville Tester	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Earl Reservoir Dam
Orange County
Lower Hudson River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Using the Corps of Engineers' screening criteria, it has been determined that the dam will pass 100 percent of the Probable Maximum Flood (PMF) without overtopping the dam. The spillway is, therefore, adjudged as "adequate." No signs of embankment instability were observed; therefore, no stability analysis will be required.

Current inspection and maintenance procedures by the owner are adequate, but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

The following remedial measures must be completed within one year:

1. Add riprap to the spillway discharge channel downstream of the plunge pool to prevent further undercutting of the right wing wall.

2. Point the deteriorated joints in the dam masonry core wall and spillway discharge channel wing wall.

3. Riprap or pave the eroded channel along the toe of the embankment with the right abutment to prevent further erosion.

4. Cut the small trees, near the junction of the left and right abutments with the dam, off at ground level and mow the embankment regularly.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
EARL RESERVOIR DAM
I.D. No. NY 203
DEC DAM No. 195C-453 LOWER HUDSON RIVER BASIN
ORANGE COUNTY, NEW YORK

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Earl Reservoir Dam (I.D. No. NY 203)
State:	New York
County:	Orange
Stream:	Tributary of Woodbury Creek
Dates of Inspection:	9 January 1981 9 March 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

Using the Corps of Engineers' screening criteria, it has been determined that the dam will pass 100 percent of the Probable Maximum Flood (PMF) without overtopping the dam. The spillway is, therefore, adjudged as "adequate." No signs of embankment instability were observed; therefore, no stability analysis will be required.

Current inspection and maintenance procedures by the owner are adequate, but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

The following remedial measures must be completed within one year:

1. Add riprap to the spillway discharge channel downstream of the plunge pool to prevent further undercutting of the right wing wall.

2. Point the deteriorated joints in the dam masonry core wall and spillway discharge channel wing wall.

3. Riprap or pave the eroded channel along the toe of the embankment with the right abutment to prevent further erosion.

4. Cut the small trees, near the junction of the left and right abutments with the dam, off at ground level and mow the embankment regularly.

5. Install a staff gage to monitor reservoir levels above normal pool.

SUBMITTED: _____
Granville Kester, Jr., P.E.
Vice President
MICHAEL BAKER, JR. of New York, INC.

APPROVED: _____
Colonel W.M. Smith, Jr.
New York District Engineer

DATE: 30 JUN 1981

Overall View of Dam
Earl Reservoir Dam
I.D. No. NY 203
9 March 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
EARL RESERVOIR DAM
I.D. No. NY 203
DEC DAM No. 453
HUDSON RIVER BASIN
ORANGE COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection - This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Earl Reservoir Dam is an earthfill embankment with a masonry core wall and a 2-foot thick concrete facing on the upstream side of the masonry wall. The core wall, which has been capped with concrete, extends above the earth embankment and forms the crest of the dam. The core wall is founded a minimum of 5 feet below original ground. There is no internal drainage system for the dam.

The dam is 460 feet long and 26.3 feet high, measured from tailwater to the top of dam. The crest width varies from 3.6 feet at the left[1] side of the dam to 7.1 feet at the center to 4.2 feet at the right side of the dam. A three sided, rectangular shaped, concrete spillway is located at the center of the dam. The crest of the spillway is a concrete broad-crested weir, 110 feet long and

[1]Looking downstream left to right.

8 inches wide, with an inclined upstream face and vertical downstream face. Water passing over the weir cascades down a series of concrete steps to a concrete apron. Water then flows over the apron through the dam via a culvert, 15 feet wide by 15.5 feet high. Upon leaving the culvert, water drops about 11 feet into a masonry plunge pool provided for energy dissipation and then passes into a riprapped channel and natural stream channel.

The outlet works consist of a 12-inch cast iron pipe and a 20-inch cast iron pipe placed through the right side of the dam. Slide gate controls for the pipes are located in a manhole on the downstream side of the dam, right side of the spillway discharge channel. The 20-inch cast iron pipe exits into the masonry plunge pool underneath the concrete spillway discharge channel. The 12-inch cast iron pipe exits into the natural stream channel downstream of the dam and has an additional slide gate at the outlet.

b. Location - Earl Reservoir Dam is located in the Town of Woodbury, Orange County, New York, on an unnamed tributary of Woodbury Creek. The coordinates of the dam are N 41° 21.8' and W 74° 8.2'. The dam and reservoir are located on the USGS 7.5 minute topographic quadrangle, Monroe, New York. A Location Plan is included in Appendix E.

c. Size Classification - Earl Reservoir Dam is 26.3 feet high and the reservoir storage capacity at the top of the dam is 172 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - Ridge Road is located about 800 feet downstream of the dam. Six homes are situated just downstream of Ridge Road. There is danger of loss of human life from large flows downstream of the dam. Therefore, Earl Reservoir Dam is considered to be in the "high" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership - The dam and reservoir are owned by the Town of Woodbury, Albany Turnpike (Route 32), Highland Mills, New York 10930. The contact person is Mr. Richard Wilson (Telephone 914-928-6707).

f. Purpose of the Dam - The dam was originally used for water supply but now is used for recreational purposes by the Town of Woodbury.

g. Design and Construction History - The dam was originally constructed in 1912 by the Town of Woodbury. The dam was reconstructed in 1980 by Raimondi Associates, Monroe, New York 10950. The designer for the reconstruction was A.G. Lichtenstein and Associates, Teaneck, New Jersey 07666.

h. Normal Operating Procedures - The reservoir is normally maintained at the elevation of the spillway weir crest at elevation 1005.1 T.B.M.[2] There are no written, formal operational procedures for Earl Reservoir Dam.

1.3 PERTINENT DATA

a. Drainage Area (Acres) - 450

b. Discharge at Dam (c.f.s.) -

Spillway at Top of Dam (Minimum)	1928
Reservoir Drain at Normal Pool Elevation = 1005.1 Feet T.B.M.	55.1

c. Elevations (Feet T.B.M.) -

Top of Dam (Concrete Cap)	1008.9
Top of Dam (Minimum on Left Abutment)	1007.9
Spillway Crest	1005.1
Reservoir Drain Inlet Invert	
12-Inch Cast Iron Pipe	986.9
20-Inch Cast Iron Pipe	986.9

d. Reservoir Surface Area (Acres) -

Top of Dam (Minimum)	19.8
Spillway Crest	16.0

e. Reservoir Storage Capacity (Acre-Feet) -

Top of Dam (Minimum)	172.0
Spillway Crest	122.0

[2]Temporary Bench Mark (T.B.M.) is top of manhole on the right side of the spillway, downstream side of the embankment. The assumed elevation is 1000.0 feet.

f. Dam -

Type: Earthfill embankment with a masonry and concrete core wall capped with concrete.	
Length (Feet)	460
Slopes (Vertical:Horizontal)	
Upstream - Embankment submerged	1:4
Downstream -	1:2.5
Crest Width (Feet)	
Concrete cap at center of dam	7.1
Concrete cap at left abutment	3.6
Concrete cap at right abutment	4.2
Concrete cap and flat portion of earth embankment at center of dam	13.5

g. Spillway -

Type: Uncontrolled, three sided, rectangular shaped concrete weir	
Length of Crest Perpendicular to Direction of Flow (feet)	110
Width of Crest Parallel to Direction of Flow (inches)	8

h. Reservoir Drain -

Type: A 12-inch cast iron pipe and a 20-inch cast iron pipe.

Control: Slide gate controls for both pipes are located in a manhole on the downstream side of the dam, right side of the spillway discharge channel. A second slide gate is present at the outlet of the 12-inch pipe.

i. Appurtenant Structures - An abandoned pump house is located downstream of the toe of the dam above the outlet of the 12-inch cast iron pipe.

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

Earl Reservoir Dam is located in a small eastern remnant of the "Appalachian Uplands" physiographic province of New York State. The province was formed by dissection of the uplifted but generally flat lying sandstones of the Middle Devonian Catskill Delta. Relief is high to moderate. Bedrock occurring in the immediate vicinity of the dam consists of undifferentiated sedimentary strata of the Hamilton Group, Middle Devonian Period (approximately 380 million years old), according to available geologic maps for New York State by J.G. Broughton and others (1970). Float exposed in the stream bed immediately below the dam indicates that the Skunnemunk Formation, consisting of sandstone and conglomerate, may actually underlie the dam. In-place bedrock was not exposed locally for examination. Faulting is not indicated in the vicinity of the dam, according to available information. The region has been repeatedly glaciated by the major ice sheet advances which occurred during the Pleistocene Epoch. The most recent ice advance ended approximately 11,000 years ago.

2.2 SUBSURFACE INVESTIGATION

According to the available (preliminary) soils report for Orange County prepared by the USDA Soil Conservation Service, local materials consist of "Bath Silt Loam" soils. These soils are described as deep (6+ feet), well drained, yellowish brown, strongly to medium acid, medium textured soils having a firm fragipan and formed in deep glacial till derived mainly from slates, shales and sandstone. Bath soils reportedly have 2 to 2-1/2 feet of moderately permeable gravelly loam overlying 1-1/2 to 4 feet of slowly permeable, very firm gravelly silt loam.

Nine borings were completed in 1977 immediately adjacent to the dam to facilitate plans for its rehabilitation. The boring logs are included in the engineering report included in Appendix E. The locations of these borings are shown on rehabilitation plans which are included in Appendix E. The borings did not encounter bedrock and extended typically through 16 to 31 feet of clay silt having small amounts of sand and gravel.

2.3 DAM AND APPURTENANT STRUCTURES

The dam was originally constructed in 1912 by the Town of Woodbury for water supply purposes. The impoundment has not been used since approximately 1940 for water supply, but has been subsequently used for recreational purposes by the town. The original construction reportedly consisted of an earth dam with a masonry core wall and centrally located masonry spillway (refer to documentation in Appendix E). The core wall extended from 5 to 15 or 20 feet below original ground according to best available information (refer to letter of 17 October 1912 in Appendix F). A 24-inch diameter reservoir drain and 12-inch diameter water supply pipe, each with slide gate controls on the upstream side of the dam, were available.

Because of the occurrence of several significant leaks during the 1970's, apparent piping of embankment materials, and plugging of the 24-inch drain, the dam was recently rehabilitated, principally for recreational purposes. Rehabilitation consisted of installation of a larger three-sided concrete spillway (110 feet total length) on the upstream side of the dam to act as a discharge "culvert" (Photo 3). The upstream side and crest of the original core wall were faced with 2 feet of concrete bonded to the masonry work with epoxy cement to reduce leakage (Photo 3). In addition, a clay blanket was placed on most of the upstream side of the rehabilitated structure and adjacent impoundment area. New intake structures were constructed for the existing 24-inch reservoir drain and 12-inch water supply pipe. A new 20-inch pipe was placed within the 24-inch pipe. The original slide gate controls were eliminated and new slide gate controls were placed in a manhole on the right downstream side of the spillway discharge channel. A Field Sketch, which illustrates present dam conditions, is included as Plate 1 in Appendix E.

The design engineer for the rehabilitation project was A.G. Lichtenstein and Associates of Teaneck, New Jersey. The construction engineer was Raimondi Associates of Monroe, New York.

2.4 CONSTRUCTION RECORDS

A single letter is available, dated 17 October 1912, which describes features related to original construction of the dam. Specifically, the letter discusses excavation of the masonry core wall trench. The letter

is included in Appendix F. The original construction is also discussed generally in the March 1978 Engineer's Report for the Rehabilitation of Earl Reservoir. The engineering report and accompanying engineering drawings are included in Appendix E.

2.5 OPERATION RECORDS

No operation records were found during this investigation.

2.6 EVALUATION OF DATA

Engineering data were obtained from files of the New York State Department of Environmental Conservation and from Mr. Ron Rothenburg of Raimondi Associates. The available data are considered adequate and reliable for Phase I Inspection purposes.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The inspection of Earl Reservoir Dam was conducted on 9 January 1981. The weather was cloudy and cold with temperatures ranging from 10°F to 15°F. At the time of inspection, approximately 3 inches of snow covered the ground. The reservoir was frozen over and the elevation of the ice was 1005.1 T.B.M. Deficiencies found during the inspection will require remedial treatment. A Field Sketch of conditions found during the inspection is included in Appendix F. The complete Visual Inspection Checklist is presented as Appendix B. Because there was a snow cover on the dam during the initial inspection, a follow-up inspection was carried out on 11 March 1981.

b. Spillway - At the time of inspection, the spillway, described in Section 1.2a., was found to be in excellent condition. There was no cracking or spalling observed in the concrete of the spillway and spillway apron as shown in Photos 2 and 3. However, the spillway was covered by ice and snow. The spillway discharge channel, as described in Section 1.2a., was found to be in good condition. The sides of the discharge channel are masonry wing walls which connect with the masonry core wall of the dam. Some masonry joints in the upper portion of the wing walls, near the core wall, are deteriorated. The right wing wall, downstream of the plunge pool is slightly undercut.

c. Embankment - The embankment was covered by about 3 inches of snow at the time of inspection. Overall, the dam, as described in Section 1.2a., appears to be in good condition. The horizontal and vertical alignments are good and no surface cracks were observed. Some joints in the masonry core wall, exposed on the downstream side of the dam, are deteriorated, as shown in Photo 6. A few small trees, as shown in Photo 7, were found near the junctions of the left and right abutments with the dam. A seep of about 3 gallons per minute occurs from a 15-foot wide area located near the toe of the embankment, right of the spillway discharge channel. A drainage culvert outlets at the far right downstream side of the dam. Drainage from the culvert has eroded a 2-foot deep ditch along the junction of the right abutment with the downstream embankment.

d. 9 March 1981 Inspection - The reservoir had risen to the spillway crest at the time of the second inspection. The only additional observation made during this inspection was that there is a saturated area covering approximately 30 square feet at the downstream toe of the dam. This area is approximately 25 feet to the right of the spillway discharge channel. There was no discernable flow from the area. This is the same area of seepage observed in the original inspection.

e. Outlet Works - The outlet works, as described in Section 1.2a., appear to be in good condition. The inlets for the 12-inch and 20-inch pipes, although not directly observed, are new. The piping system and gates located in the manhole are newly constructed. The additional gate on the outlet of the 12-inch pipe is rusty (see Photo 5).

f. Downstream Channel - The downstream channel is a natural stream channel which flows in a narrow valley. The side slopes of the valley are steep and wooded. The stream slope is steep, approximately 9 percent.

g. Reservoir - The slopes immediately adjacent to the reservoir are shallow and largely covered with grass. Steep wooded slopes are present at the upper end of the reservoir. There were no reservoir monitoring instruments observed.

3.2 EVALUATION

Visual inspection revealed several deficiencies in this structure. The following items were noted:

1. A seep is located near the toe of the embankment, right of the spillway discharge channel.
2. The right wing wall is undercut downstream of the plunge pool.
3. Some of the joints in the masonry core wall are deteriorated.
4. Some of the joints in the upper portion of the wing walls are deteriorated.
5. Drainage from a culvert at the far right downstream side of the dam has eroded a 2-foot deep ditch along the downstream toe of the dam.
6. A few small trees are near the junctions of the left and right abutments with the dam.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The operation of the dam is an automatic function controlled by the crest of the spillway.

4.2 MAINTENANCE OF THE DAM

Maintenance of the dam is the responsibility of the owner. There are no formal inspection and maintenance procedures for Earl Reservoir Dam.

4.3 WARNING SYSTEM

There is no warning procedure or emergency action plan in the event of dam failure.

4.4 EVALUATION

It is recommended that formal inspection and maintenance procedures be developed and implemented. Maintenance items should be corrected annually. A warning system and emergency action plan should be developed and implemented.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the watershed above Earl Reservoir Dam was made using the Monroe and Maybrook, New York USGS 7.5 minute quadrangles. The drainage basin is wooded. Slopes near the reservoir are moderate, approximately 13%, and are steep, approximately 33%, in the upper reaches of the watershed. The total drainage area is 450 acres (0.70 square miles).

5.2 ANALYSIS CRITERIA

An hydrologic analysis of the watershed and hydraulic analysis of the dam was conducted using the U.S. Army Corps of Engineers' Flood Hydrograph Package HEC-1 DB computer program (Reference 12, Appendix D). The unit hydrograph was defined using the Snyder Unit Hydrograph Method. Estimates of Snyder hydrograph coefficients were based upon average coefficients from the Hydrologic Flood Routing Model for Lower Hudson River Basin (Reference 16, Appendix D). Precipitation data was taken from Hydrometeorological Report No. 33 (Reference 8, Appendix D). Rainfall losses were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.1 inch per hour thereafter. The hydraulic capacity of the dam, reservoir, and spillway was determined by incorporating the Modified Puls Routing Method. All flood routings were begun with the reservoir at normal pool level. Outlet discharge capacity was computed by hand. The Probable Maximum Flood (PMF) and 1/2 Probable Maximum Flood (1/2 PMF) were developed and routed through the reservoir.

5.3 SPILLWAY CAPACITY

With the reservoir level at the minimum top of dam, the spillway capacity was determined to be 1928 cubic feet per second (c.f.s.).

5.4 RESERVOIR CAPACITY

The storage capacity of Earl Reservoir at normal pool is 122 acre-feet. The storage capacity of the reservoir at the minimum top of dam is 172 acre-feet. Therefore, flood control storage of the reservoir between the spillway crest and top of dam is 50 acre-feet. This volume represents a total of 1.34 inches of runoff from the watershed.

5.5 FLOODS OF RECORD

No records concerning the effects of significant floods on the dam and spillway are available.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 1928 c.f.s. before overtopping would occur. The peak outflow of the PMF is 1778 c.f.s. and the 1/2 PMF is 883 c.f.s. Therefore, the spillway is capable of passing 100% of the PMF.

5.7 RESERVOIR EMPTYING POTENTIAL

The reservoir can be drawn down by means of a 12-inch and a 20-inch cast iron pipe, as described in Section 1.2a. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 35 hours. This is equivalent to an approximate drawdown rate of 0.5 feet per hour, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

5.8 EVALUATION

Earl Reservoir Dam is a "small" size - "high" hazard dam requiring the spillway to pass a flood in the range of the 1/2 PMF to PMF. The PMF and 1/2 PMF were routed through the watershed and dam. It was determined that the spillway is capable of passing 100% of the PMF without overtopping the dam. The spillway is, therefore, judged to be "adequate".

Conclusions pertain to present conditions and the effect of future development on the hydrology has not been considered.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF EMBANKMENT STABILITY

a. Visual Observations - No signs of instability were noted during the visual inspection. Minor problems observed which could potentially affect the stability of the dam include:

1. A ditch approximately 2 feet deep has been eroded along a portion of the junction of the right abutment and downstream embankment (see Photo 7). This steepening of the foundation for the embankment could result in slumping if erosion is allowed to continue.

2. A seep totalling approximately 3 gallons per minute occurs from a 15-foot wide area located just downstream of the left end of the right downstream embankment.

b. Design and Construction Data - Design and rehabilitation information concerning the stability of the embankment was not available.

c. Operating Records - Operating records are not available.

d. Post Construction Changes - The dam was recently rehabilitated as discussed in Section 2. Rehabilitation measures that are related to the stability of the dam include:

1. The spillway was totally reconstructed and its capacity increased, thereby reducing the possibility of overtopping.

2. Leakage through the dam was reduced by facing the original masonry core wall with concrete and installing a clay blanket along the upstream slope of the dam and immediate reservoir area.

3. Reconstructed embankment slopes are gentle (flatter than 1V:2.5H).

4. The original 24-inch reservoir drain pipe, which had become inoperable, was replaced with a new 20-inch cast iron pipe grouted into the old one, thereby re-establishing the capability of rapid drawdown as necessary.

6.2 STABILITY ANALYSIS

The results of a previous stability analysis were not available for reference during this evaluation. The dam might technically be considered a diaphragm type, but is considered to be more comparable to a zoned earthfill dam. The dam is 26.3 feet high, as measured from the crest of the dam to the tailwater in the plunge pool between the wing walls. The width of the crest varies; it is widest in the center and narrower at each end. The width near the center is approximately 13.5 feet, including the width of the exposed core wall plus the flat top portions of the upstream and downstream embankments. The most narrow width is 3.6 feet at the left end of the dam where only the concrete faced masonry core wall is present, and there is virtually no embankment on either side. The core of the dam is founded in a positive cut-off trench.

The upstream embankment slope is 1V:4H, as shown on the rehabilitation plans in Appendix E. The downstream embankment slope was measured at 1V:2.5H, although it is shown as 1V:2H on the rehabilitation plans. The dam is subject to rapid drawdown (greater than 0.5 feet per day) due to the availability of the 12- and 20-inch outlets.

The slopes of the embankments are not overly steep and appeared to be stable at the time of inspection. Therefore, a stability analysis of the structure is not considered necessary at this time.

6.3 SEISMIC STABILITY

Earl Reservoir Dam is located in Seismic Zone 1 which presents no hazard from earthquakes, according to the Recommended Guidelines for Safety Inspection of Dams. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety - Examination of available documents and visual inspections of Earl Reservoir Dam did not reveal any hazardous conditions.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, it has been determined that the spillway is capable of passing 100% of the PMF without overtopping the dam. The spillway is therefore adjudged as "adequate". A stability analysis of the dam is not considered necessary at this time.

b. Adequacy of Information - The engineering information reviewed is considered adequate for a Phase I Inspection.

c. Need for Additional Investigation - Considering the present condition of the dam and reservoir, there is no need for additional investigation at this time.

d. Urgency - The owner must complete the recommended corrective measures within one year of notification.

7.2 RECOMMENDED MEASURES

It is recommended that formal inspection and maintenance procedures be developed and implemented. Maintenance items should be corrected annually. A warning system and emergency action plan should be developed and implemented.

The seep near the toe of the embankment should be examined at regular intervals and after periods of heavy rain for turbidity and increase in flow, which may indicate the potential for piping of embankment material. If turbidity and increased flows are noted, a qualified geotechnical engineering firm should be retained to perform a stability check of the dam and plan remedial measures.

The following remedial measures must be completed within one year of notification:

1. Add riprap to the spillway discharge channel downstream of the plunge pool to prevent further undercutting of the right wing wall.

2. Point the deteriorated joints in the dam masonry core wall and spillway discharge channel wing wall.

3. Riprap or pave the eroded channel along the toe of the embankment with the right abutment to prevent further erosion.

4. Cut the small trees, near the junction of the left and right abutments with the dam, off at ground level and mow the embankment regularly.

5. Install a staff gage to monitor reservoir levels above normal pool.

APPENDIX A

PHOTOGRAPHS

CONTENTS

EARL RESERVOIR DAM

Photo 1. Spillway Crest and Upstream Face of Dam
9 March 1981

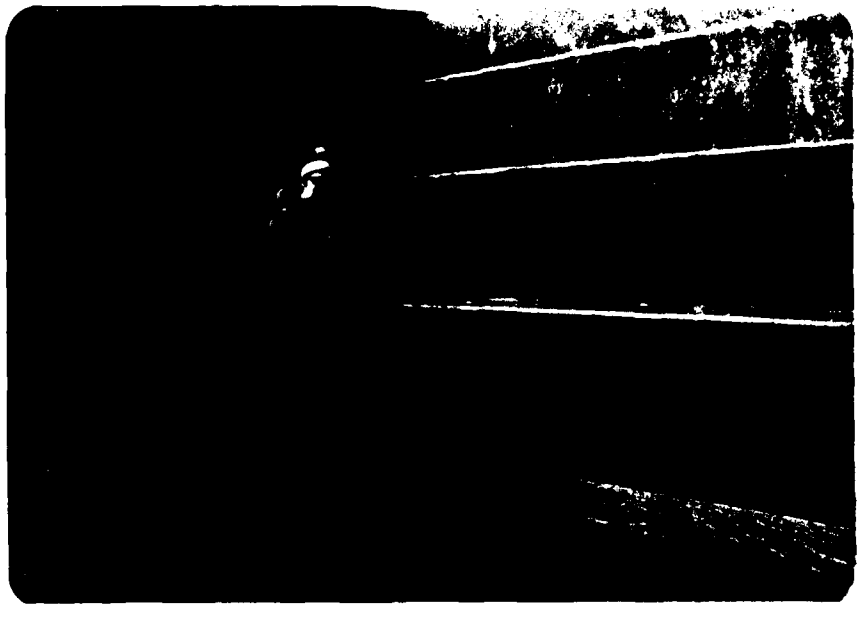


Photo 2. Energy Dissipators (Steps) in Spillway
9 March 1981

Photo 3. Notch Through Masonry Core for Spillway
9 March 1981

Photo 4. 20-Inch Outlet Beneath Spillway Apron
9 January 1981

Photo 5. 12-Inch Outlet and Slide Gate,
Abandoned Pump House
9 March 1981

Photo 6. Condition of Masonry Core Wall Exposed
on Downstream Side of Dam
9 March 1981

Photo 7. Eroded Channel at Junction of Downstream Embankment with Right Abutment
9 March 1981

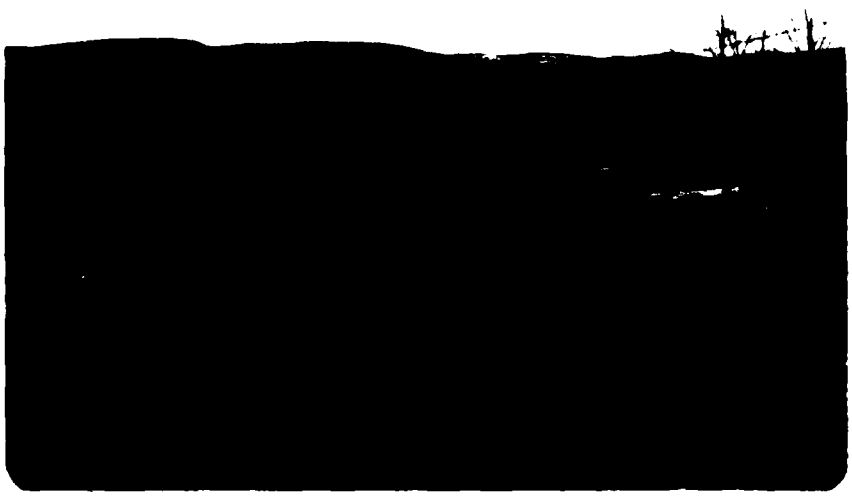


Photo 8. Downstream Hazard Area
9 March 1981

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Earl Reservoir Dam

Fed. I.D. # NY 203 DEC Dam No. 195C-453

River Basin Hudson

Location: Town Woodbury County Orange

Stream Name Unnamed

Tributary of Woodbury Creek

Latitude (N) 41°21.8' Longitude (W) 74°08.2'

Type of Dam Earth dam with a masonry/concrete core wall

Hazard Category High

Date(s) of Inspection 9 January 1981

Weather Conditions Partly cloudy, 10°F. to 15°F., 3 in. snow cover on dam

Reservoir Level at Time of Inspection Elevation 1005.1 ft. T.B.M.*

b. Inspection Personnel Jeffrey Quay, Larry Diday, David Hupe

c. Persons Contacted (Including Address & Phone No.)

Richard Wilson	Raimondi Associates, P.C.
3 Ridge Place	110 Stage Road
Highland Mills, NY 10930	Monroe, NY 10950
914/928-6707 (home phone)	914/782-8681

d. History:

Date Constructed 1912 Date(s) Reconstructed 1980

Designer (Reconstruction) A.G. Lichtenstein & Assoc., Teaneck, NJ 07666

Re-Constructed By (Construction Eng.) Raimondi Assoc., Monroe, NY 10950

Owner Town of Woodbury

*Temporary Bench Mark (T.B.M.) is top of manhole on the right side of the spillway, downstream side of the embankment. Assumed elevation is 1000.0 ft.

2) Embankment

a. Characteristics

(1) Embankment Material Clayey silt.

(2) Cutoff Type Core founded a minimum of 5 ft. below natural ground line.

(3) Impervious Core Original masonry core with new 2 ft. thick upstream concrete facing bonded to masonry with epoxy cement.

(4) Internal Drainage System None observed

(5) Miscellaneous

b. Crest - Masonry core wall capped with concrete extends higher than the embankment and forms the crest.

(1) Vertical Alignment Satisfactory

(2) Horizontal Alignment Satisfactory

(3) Surface Cracks None observed

(4) Miscellaneous The concrete construction joints are tight. Expansion joint material was not used.

c. Upstream Slope

(1) Slope (Estimate) (V:H) Could not measure; reservoir frozen over. Design plans for dam rehabilitation indicate slope is 1V:4H.

(2) Undesirable Growth or Debris, Animal Burrows None anticipated. The upstream slope is entirely inundated at normal pool level.

(3) Sloughing, Subsidence, or Depressions Unknown

(4) Slope Protection The design plans for dam rehabilitation indicate 6 in. of gravel in the vicinity of the spillway.

(5) Surface Cracks or Movement at Toe Unknown

d. Downstream Slope

(1) Slope (Estimate - V:H) 1V:2.5H measured during the field inspection.

(2) Undesirable Growth or Debris, Animal Burrows None observed

(3) Sloughing, Subsidence or Depressions The embankments appear to be in good condition. Some joints in the masonry core exposed on the downstream side of the dam are deteriorated.

(4) Surface Cracks or Movement at Toe Refer to 2)e of this checklist

(5) Seepage No seepage was observed on the downstream slopes.

(6) External Drainage System (Ditches, Trenches, Blanket) None

(7) Condition Around Outlet Structure The masonry core wall beneath the concrete spillway apron encases the 20 in. outlet adequately.

(8) Seepage Beyond Toe Seepage (total flow approx. 3 g.p.m.) occurs from a 15 ft. wide area located near the toe of the embankment right of the spillway.

e. Abutments - Embankment Contact A few small trees are located near the junctions of the left and right abutments with the dam.

(1) Erosion at Contact A drainage culvert outlets at the far right end of the dam on the downstream side. The drainage has eroded a 2 ft. deep ditch along the junction of the right abutment with the downstream embankment.

(2) Seepage Along Contact None observed

3) Drainage System

a. Description of System None observed

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) None observed

5) Reservoir

a. Slopes The slopes are very gentle and largely grass covered near the dam. Very steep wooded slopes are present at the upper end of the watershed.

b. Sedimentation Unknown. The reservoir was frozen over.

c. Unusual Conditions Which Affect Dam

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Ridge Road is situated 800 ft. downstream. A large masonry arch culvert carries stream flow beneath the road. Just downstream of Ridge Road are six homes which are likely to be affected in the event of dam failure.

b. Seepage, Unusual Growth None was observed.

c. Evidence of Movement Beyond Toe of Dam None observed

d. Condition of Downstream Channel The immediate downstream channel is narrow with steep sides.

7) Spillway(s) (Including Discharge Conveyance Channel)

a. General The spillway consists of a 3 sided concrete weir forming a rectangular drop inlet on the upstream center of the dam. Three concrete steps exist inside the drop inlet where overflow occurs for energy dissipation. A concrete apron carries subsequent flow through a notch in the masonry core. Flows drop from the apron to a plunge pool below masonry wing walls to protect the toe of the dam.

b. Condition of Service Spillway The spillway appears to be in excellent condition. Total length of the weir is 110 ft.

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel The discharge channel area is protected from erosion by old masonry wing walls and an old bridge foundation. The upper wing walls closest to the masonry core, which protect the downstream embankments, are deteriorated. The right wing walls (bridge foundation) furthest downstream has been undercut slightly and could cave in if undercutting continues.

8) Reservoir Drain/Outlet

Type: Pipe 2 outlets Conduit _____ Other _____

Material: Concrete _____ Metal cast iron both outlets Other _____

Size: 1 outlet 12 in., 1 outlet 20 in. Length 170 ft. and 63 ft. respectively

Invert Elevations: Entrance 12 in.-unknown (ice covered), 20 in.-unknown (ice covered)

Exit 12 in.-981.4 T.B.M., 20 in.-unknown (ice blockage)

Physical Condition (Describe): Unobservable Inlets not observed, but are new.

Material: Good

Joints: Unknown Alignment Unknown

Structural Integrity: Structural integrity should be satisfactory. The 20 in. pipe is a new pipe grouted into the original 24 in. pipe. The existing 12 in. pipe upstream of the core wall has been encased in concrete.

Hydraulic Capability:

Means of Control: Gate both outlets Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Other Unknown

Present Condition (Describe): The gate at the discharge of the 12 in. outlet is rusty. The condition of the gate for the 20 in. outlet is unknown. The control is in the manhole immediately right of the spillway. The gate is new. A second gate for the 12 in. outlet is shown on the rehabilitation drawings as being controlled from the manhole.

9) Structural See Spillway

a. Concrete Surfaces

b. Structural Cracking

c. Movement - Horizontal & Vertical Alignment (Settlement)

d. Junctions with Abutments or Embankments

e. Drains - Foundation, Joint, Face _____

f. Water Passages, Conduits, Sluices _____

g. Seepage or Leakage _____

h. Joints - Construction, etc. _____

i. Foundation _____

j. Abutments _____

k. Control Gates _____

l. Approach & Outlet Channels _____

m. Energy Dissipators (Plunge Pool, etc.) _____

n. Intake Structures _____

o. Stability _____

p. Miscellaneous _____

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition An abandoned pump house is located above the outlet of the 12 in. drain.

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject EARL RESERVOIR DAM S.O. No. _____
APPENDIX C - HYDROLOGIC AND Sheet No. ____ of ____
HYDRAULIC COMPUTATIONS Drawing No. _____
Computed by _____ Checked by _____ Date _____

SUBJECT	PAGE

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

		Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1)	Top of Dam	1007.9 T.B.M.*	19.8	172.
2)	Design High Water (Max. Design Pool)	1007.6 T.B.M.	19.7	167.
3)	Auxiliary Spillway Crest	-	-	-
4)	Pool Level with Flashboards	-	-	-
5)	Service Spillway Crest	1005.1 T.B.M.	16.0	122.

DISCHARGES

		Volume (cfs)
1)	Average Daily	30
2)	Spillway @ Maximum High Water - Top of Dam -	1,928.
3)	Spillway @ Design High Water	1,392.
4)	Spillway @ Auxiliary Spillway Crest Elevation	-
5)	Low Level Outlet	-
6)	Total (of all facilities) @ Maximum High Water	1,928.
7)	Maximum Known Flood	-
8)	At Time of Inspection	25

*Temporary Bench Mark (T.B.M.) is top of manhole on the right side of the spillway, downstream side of the embankment. Assumed elevation is 1,000.0 ft.

CREST: ELEVATION: 1005.1 T.B.M.

Type: Masonry core wall capped with concrete.

Width: Varies from 3.6 to 7.1 ft. Length: 460 ft.

Spillover Uncontrolled rectangular concrete weir.

Location Center of dam.

SPILLWAY:

SERVICE		AUXILIARY
1005.1 T.B.M.	Elevation	None
Concrete weir	Type	
Width = 8 in. length = 110 ft.	Width	

Type of Control

X	Uncontrolled	

Controlled:

None	Type (Flashboards; gate)	
-	Number	
-	Size/Length	
	Invert Material	
	Anticipated Length of Operating Service	
16.5 ft.	Chute Length	
-	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type: None were observed.

Location:

Records:

Date:

Max. Reading:

FLOOD WATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (mechanisms):

Gate valves in a manhole, located on the downstream side of the embankment, control a 12 in. cast iron pipe and a 20 in. cast iron pipe.

DRAINAGE AREA: 0.70 sq. mi.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Wooded

Terrain - Relief: Moderate (13%) slopes near reservoir. Steep (33%) slopes in upper reaches of watershed.

Surface - Soil: Poor permeability.

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

None

Potential Sedimentation problem areas (natural or man-made; present or future)

Sedimentation is not expected to be a problem due to the natural wooded undeveloped watershed.

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

There are no potential backwater problem areas.

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter: None

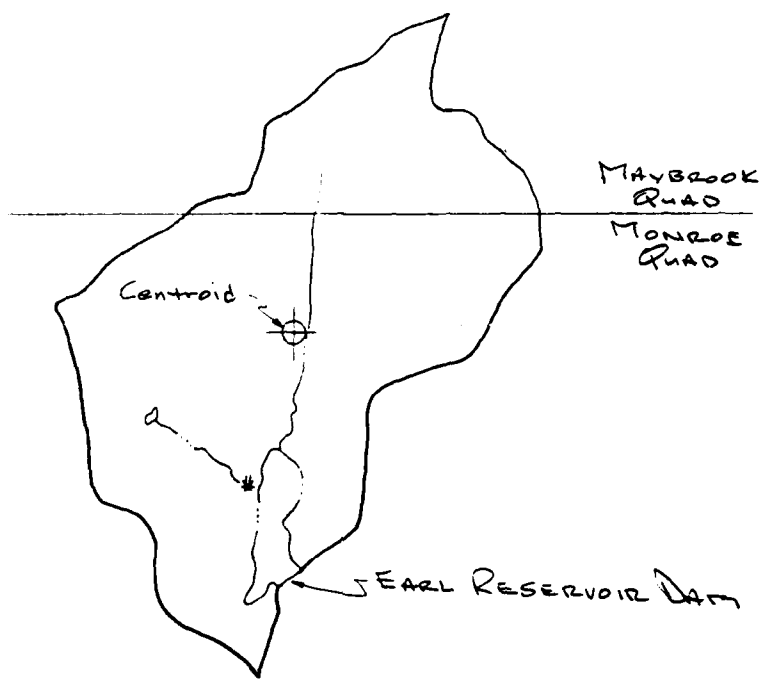
Location:

Elevation:

Reservoir:

Length @ Maximum Pool (Top of dam) 1,700 ft.

Length of Shoreline (@ Spillway Crest) 3,900 ft.



EARL RESERVOIR DAM
DRAINAGE AREA MAP

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

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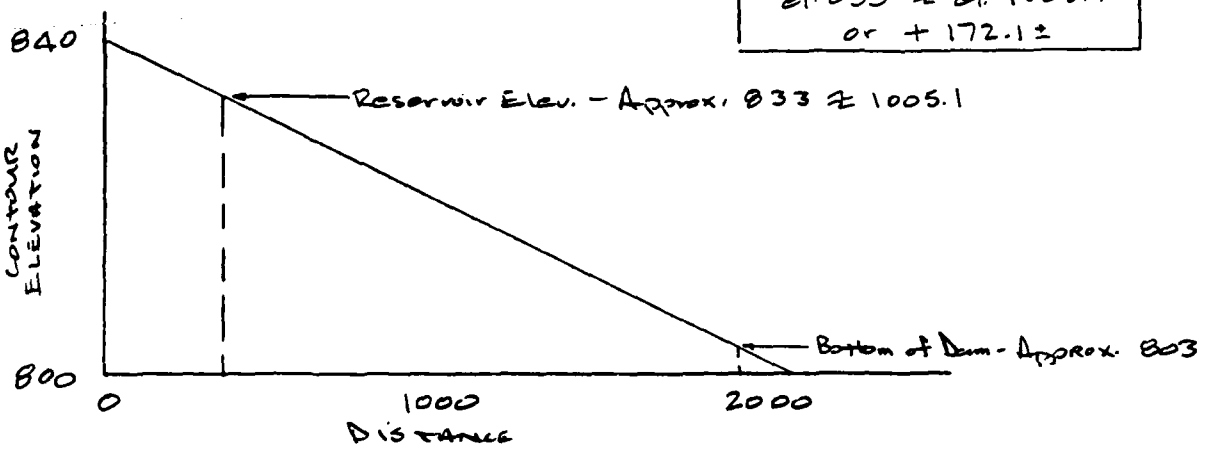
Beaver, Pa. 15009

Subject N.Y. Dam Insp. S.O. No. 13888-00-ARA-09
EARL RESERVOIR DAM Sheet No. 6 of 37
Drawing No.
Computed by DCK/JE Checked by JE/WLS Date 1/12/01

DRAINAGE AREA - 3.80 +1.07 (+1.87) in^2 - 4147.20 Ac - 0.70 mi^2
LAKE AREA (elev 833±) - 0.13 in^2 - 11.94 ac - EL. 1005.1 16 Ac from Design Report
elev 840 - 0.27 in^2 - 24.79 ac EL. 1012.1
860 - 0.54 in^2 - 49.59 ac EL. 1032.1

L = 3.5 in - 7000 ft - 1.33 mi
L_{CA} = 1.4 in - 2800 ft - 0.53 mi

To convert Quad datum to Field note datum
el. 833 ± el. 1005.1
or + 172.1 ±



From const. plans -
Lake bottom @ 810 ± 982.1

PRECIPITATION DATA

HMR-33 - ZONE 1

PMP 24 hr. - 200 mi^2 - 21.6 in.
D.A. - Less than 10 mi^2

Duration	%	Inches
6 hr. PMP	111	= 23.98
12 hr PMP	123	= 26.57
24 hr PMP	133	= 28.73
48 hr PMP	142	= 30.67

TP-40

100 YR - 24 hr. Rainfall = 7.5 inches
" 12 hr " 6.4 "
" 6 hr " 5.3 "

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Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 7 of 37
Snyders Coeff. & Storage Drawing No.
Computed by LAD Checked by JAQ Date 2/4/81

Snyders Unit Hydrograph Coefficients

$C_p = 0.63$

$C_T = 2.0$

$L = 1.33$ Mi.

$L_{CA} = 0.53$ Mi

$T_p = C_T (L \times L_{CA})^{0.3}$

$= 2.0 (1.33 \times 0.53)^{0.3}$

$= 1.80$

Reservoir Storage

	Design Plans	Survey (T.B.M) for HEC 1
Top of Dam (Conc.)	El. 832.0	El. 1008.9
Crest of Spillway	El. 828.2	El. 1005.1
Bottom of Res. (Invert of 12" & 20" Pipe Inlet)	El. 810.0	El. 986.9

From Design Report - Res. Surface Area at Crest of spillway = 16.0 Acres. 16 Ft. Below Crest Surface Area 90% Reduced. = 1.6 Acres. 3.8 Ft. Above Crest Area = 21.5 Acres

Therefore: Bottom of Res. (0 Acres) = El. 986.9
1.6 Acres = El. 989.1
16 Acres = El. 1005.1
21.5 Acres = El. 1008.9
*24.8 Acres = El. 1012.1
*49.6 Acres = El. 1032.1

*Acerage from U.S.G.S. Quadrangle

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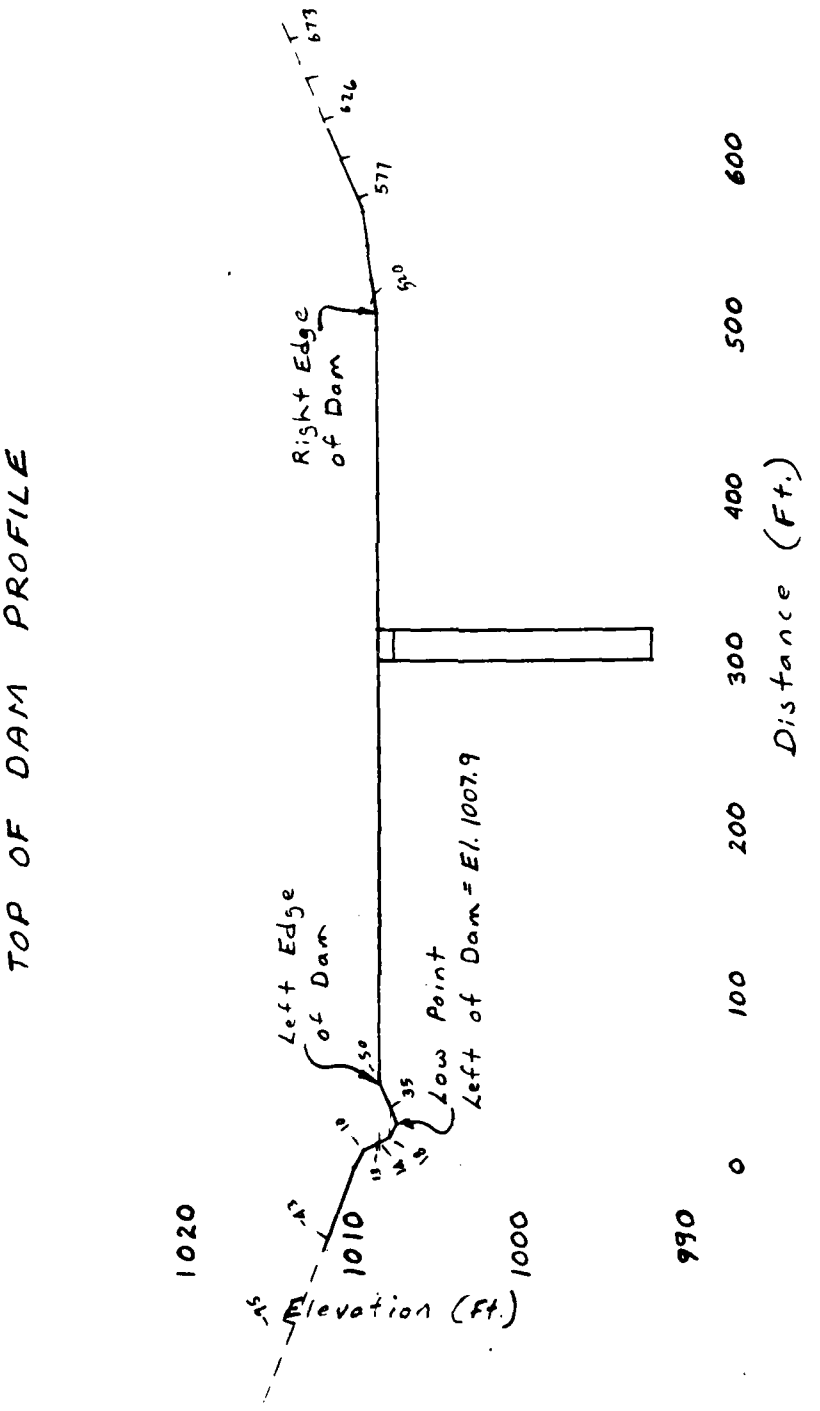
Subject New York Dams — S.O. No.
Earl Reservoir Dam — Sheet No. 8 of 37
Drawing No.
Computed by LAD — Checked by NAR — Date 1/15/91



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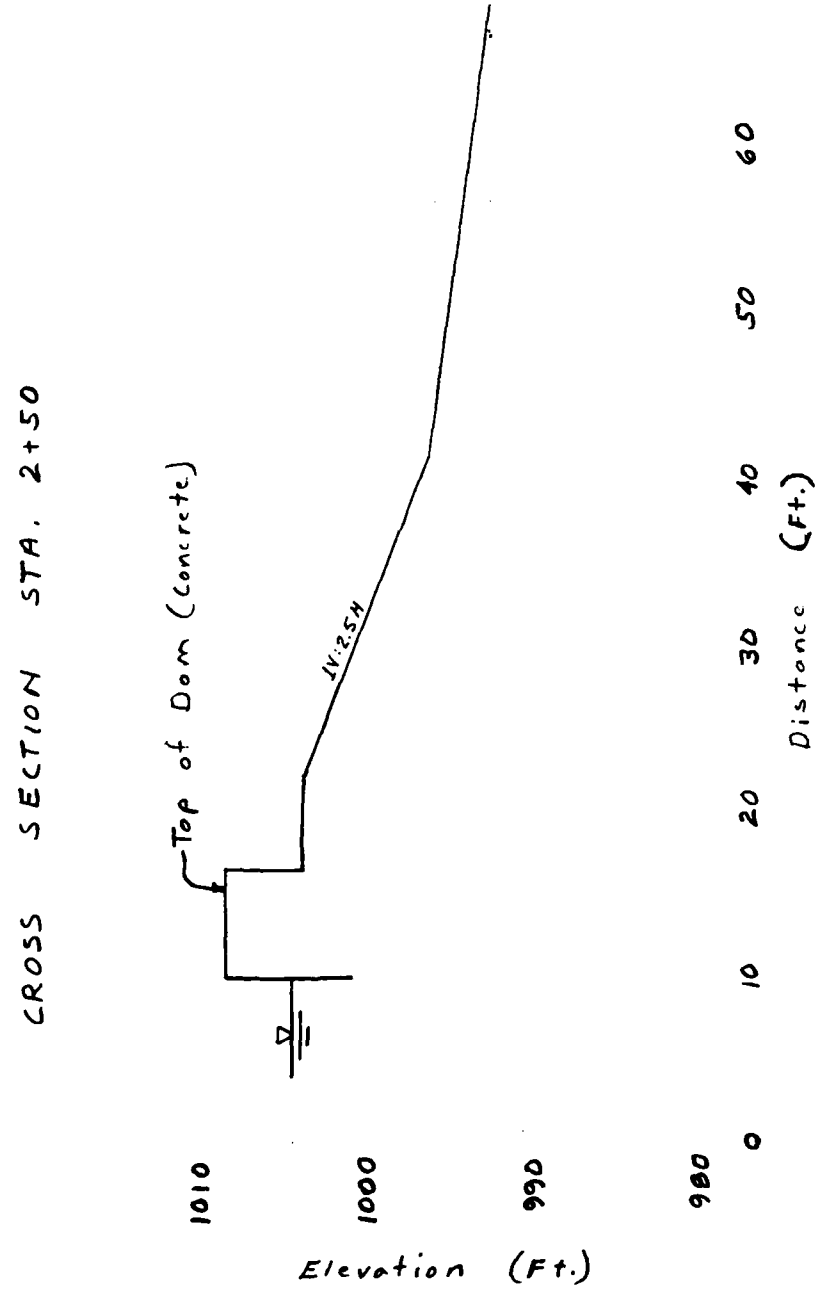
Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 9 of 37
Drawing No.
Computed by GAD Checked by KAR Date 1/15/81



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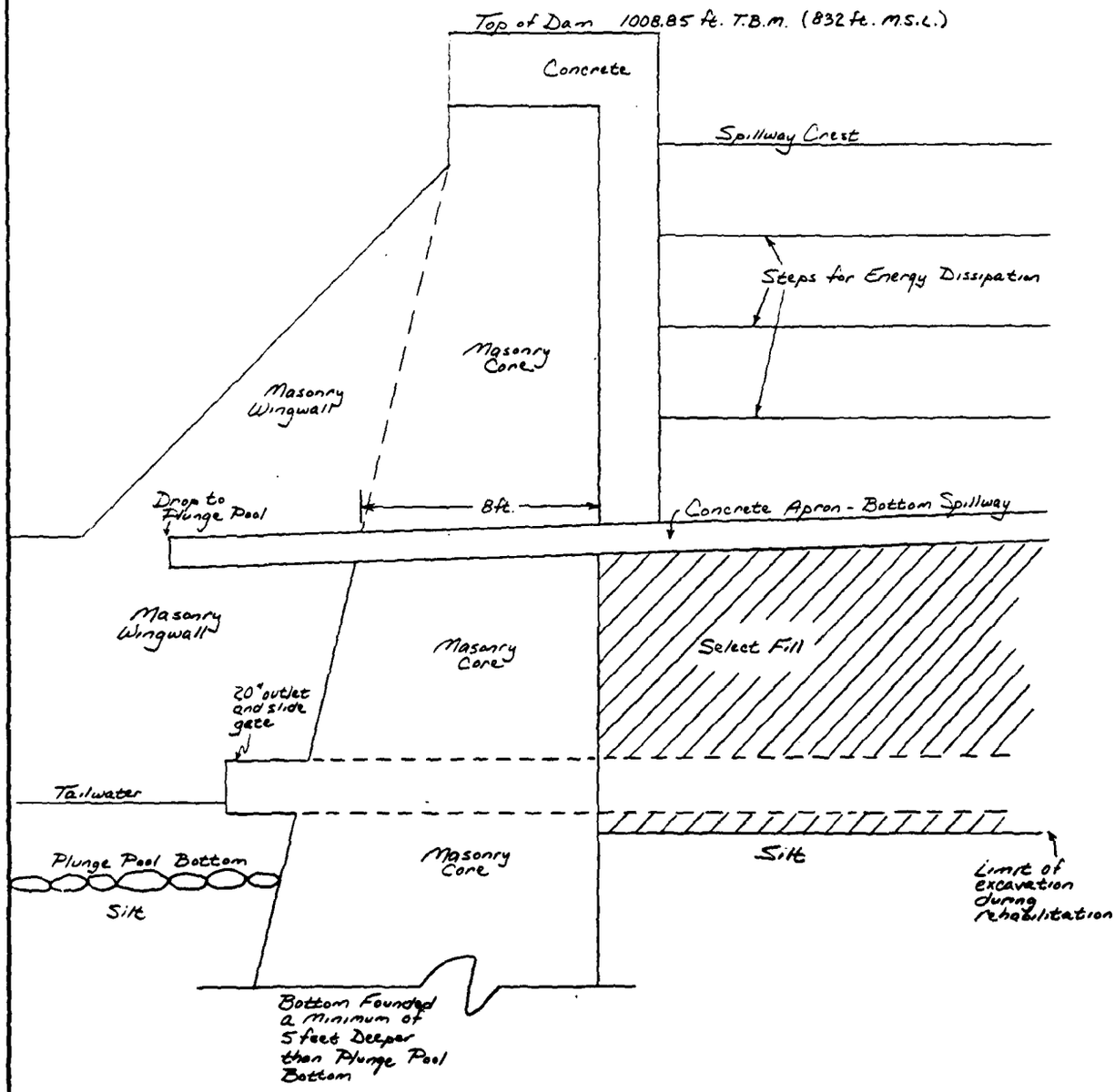
Subject Earl Reservoir Dam S.O. No.
Cross-Section at Spillway Sheet No. 10 of 37
Drawing No.
Computed by DWH Checked by Date 1/19/81



CROSS SECTION AT SPILLWAY
NOTCH THROUGH CORE WALL
Scale: 1"=5'

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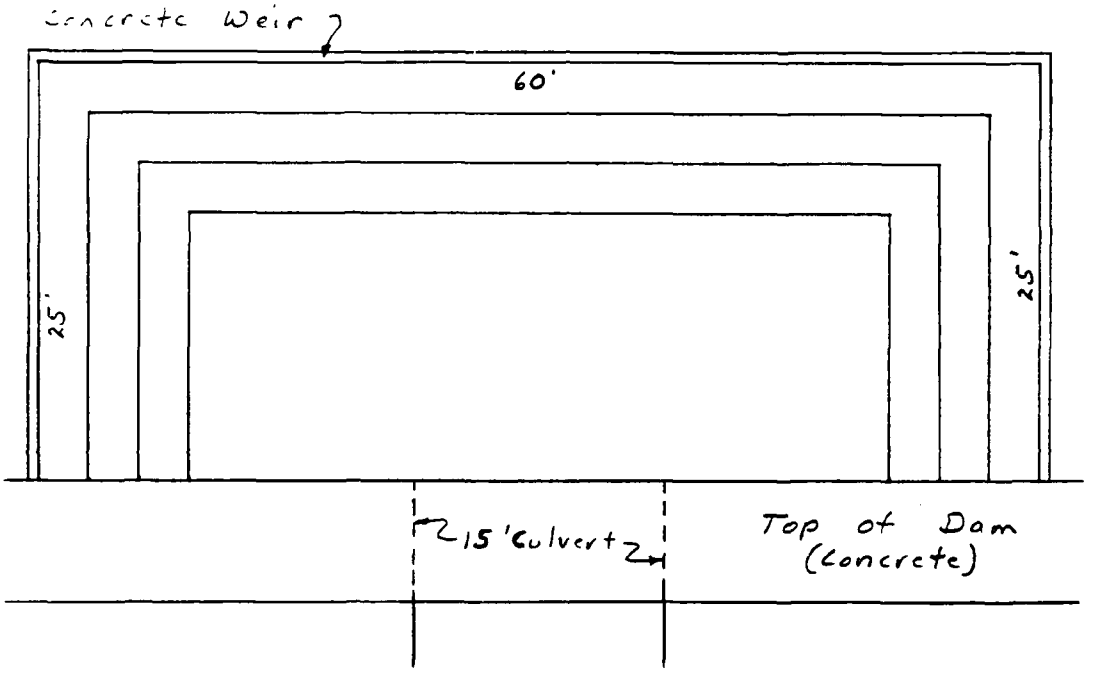
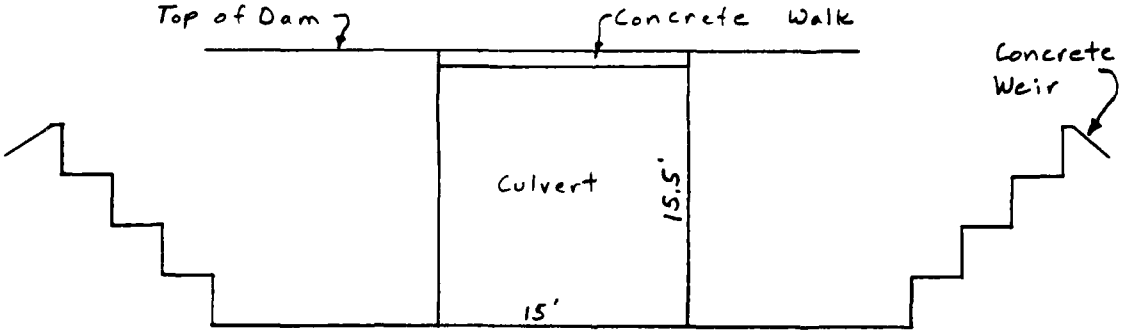
Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 11 of 37
Spillway Drawing No.
Computed by LAD Checked by KAR Date 1/15/81

Concrete Spillway - Plan, Scale 1" = 10'



Concrete Spillway - Profile, Scale 1" = 10'



Total Weir Length = 110' Breadth of Crest = 8"
Size of Culvert = 15' x 15.5'

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Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 12 of 37
Spillway Rating Drawing No.
Computed by LAD Checked by JAQ Date 1/15/81

Weir Flow over Concrete Weir

$Q = CLH^{3/2}$ $L = 110'$ Ft.

H varies from 0.5 Ft to 8.0 Ft.

C varies with H, King and Brater Handbook Pg 5-44 Table 5-11

Elevation (Ft.)	H (Ft.)	L (Ft.)	C	Q (cfs)	
1005.1	0	110.	0.	0	
1006.1	1.0	110.	3.41	375.1	
1007.1	2.0	110.	3.65	1135.6	
1008.1	3.0	110.	3.72	2126.3	↓ CONTROLS
1009.1	4.0	110.	3.73	3282.4	
1010.1	5.0	110.	3.73	4587.3	
1011.1	6.0	110.	3.73	6030.2	
1012.1	7.0	110.	3.73	7598.9	
1013.1	8.0	110.	3.73	9284.0	

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Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 13 of 37
Spillway Rating Drawing No.
Computed by LAD Checked by JAQ Date 1/15/81

Orifice Flow for Culvert

$Q = CA(2gH)^{1/2}$

$= (.55)(232.5)(64.4\,H)^{1/2}$

$= 1026.2\,(H)^{1/2}$

$A = 15 \times 15.5 = 232.5$ Sq. Ft.

$g = 32.2$ Ft/sec

$C = 0.55$ Pg 4-11 King and Brater Handbook

H varies from 7.75 + 12.75 Ft. and is measured from the Center of the Culvert.

Elevation (Ft.)	H (Ft.)	Q (cfs)	
1008.1	7.75	2856.8	
1009.1	8.75	3035.5	↓ CONTROLS
1010.1	9.75	3204.3	
1011.1	10.75	3364.6	
1012.1	11.75	3517.6	
1013.1	12.75	3664.2	

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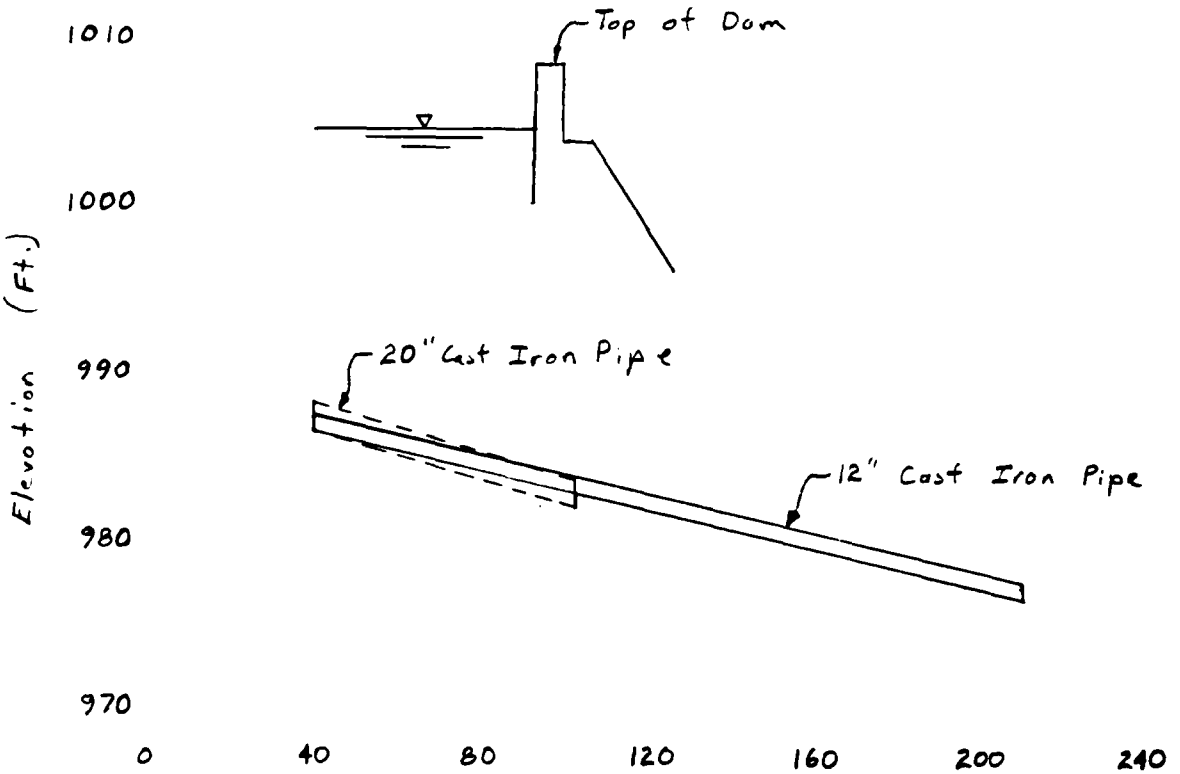
Subject New York Dam: Earl Reservoir Dam Outlet Works
S.O. No.
Sheet No. 14 of 37
Drawing No.
Computed by LAD Checked by JAG Date 2/9/81

Profile of Outlet Works



	20" Cast Iron Pipe	12" Cast Iron Pipe
Entrance Invert	El. 986.9	El. 986.9
Outlet Invert	El. 982.4	El. 976.9
Length	63 Ft.	170 Ft.
Slope	0.0714 ✓	0.0588 ✓

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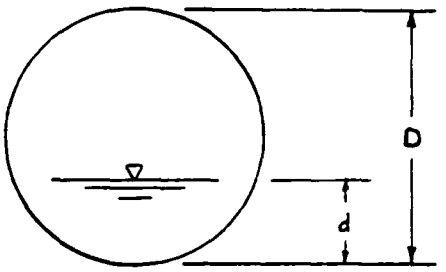
Beaver, Pa. 15009

Subject New York Dams — S.O. No.
Earl Reservoir Dam — Sheet No. 15 of 37
20" Pipe Rating — Drawing No.
Computed by LED — Checked by JAQ — Date 2/9/81

Flow in Pipes Partly Full

"Design of Small Dams" Pages 558 and 559



D = Pipe Dia = 20" = 1.67 Ft.
d = Depth of Flow
s = Slope = 0.0714
Pipe is Cast Iron
n = 0.014

$\frac{d}{D} = \frac{.5}{1.67} = 0.30$ $\quad 0.5225 = \frac{Q_c}{D^{5/2}} = \frac{Q_c}{(1.67)^{5/2}}$ $\quad Q_c = \underline{1.9 \text{ cfs}}$ ✓

$\frac{d}{D} = \frac{.5}{1.67} = 0.30$ $\quad 0.0907 = \frac{Q\,n}{D^{8/3}\,S^{1/2}} = \frac{Q(0.014)}{(1.67)^{8/3}(.0714)^{1/2}}$ $\quad Q = 6.8 \text{ cfs}$ ✓

$\frac{d}{D} = \frac{1.0}{1.67} = 0.60$ $\quad 1.9773 = \frac{Q_c}{D^{5/2}} = \frac{Q_c}{(1.67)^{5/2}}$ $\quad Q_c = \underline{7.1 \text{ cfs}}$ ✓

$\frac{d}{D} = \frac{1.0}{1.67} = 0.60$ $\quad 0.311 = \frac{Q\,n}{D^{8/3}\,S^{1/2}} = \frac{Q(0.014)}{(1.67)^{8/3}(.0714)^{1/2}}$ $\quad Q = 23.3 \text{ cfs}$ ✓

Critical Depth Controls

El. 986.9 $\quad Q = 0$ ✓
El. 987.4 $\quad Q = 1.9$ cfs ✓
El. 987.9 $\quad Q = 7.1$ cfs ✓

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Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 16 of 37
20" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/21

Pipe Flow

$$Q = \frac{A(2gH)^{1/2}}{[1 + K_o + K_p(L)]^{1/2}}$$

$$= \frac{2.16(64.4H)^{1/2}}{[1 + 0.78 + .0185(63)]^{1/2}}$$

$$= 10.10(H)^{1/2}$$

Pipe = 20" Dia. Cast Iron

$A = \pi r^2 = 2.18$ Sq. Ft.

$g = 32.2$ Ft./sec.

$L = 63$ Ft.

Pipe Losses

Entrance Loss (K_o) = 0.78
Pg 5.5-6 SCS NEH-5

Head Loss (K_p) = 0.0185
$n = 0.014$ Pg 5.5-4
SCS NEH-5

H varies from 4.9 Ft. to 21.0 Ft. and is measured from the Top of Pipe at Outlet = El. 984.1

Elevation (Ft.)	H (Ft.)	Q (cfs)
989.0	4.9	22.4
990.0	5.9	24.5
991.0	6.9	26.5
992.0	7.9	28.4
993.0	8.9	30.1
994.0	9.9	31.8
995.0	10.9	33.3
996.0	11.9	34.8
997.0	12.9	36.3
998.0	13.9	37.7
999.0	14.9	39.0
1000.0	15.9	40.3
1001.0	16.9	41.5
1002.0	17.9	42.7
1003.0	18.9	43.9
1004.0	19.9	45.1
1005.1	21.0	46.3

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 17 of 37
20" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/81

Orifice Flow

$$Q = CA(2gH)^{.5}$$
$$= (0.6)(2.16)(64.4\ H)^{.5}$$
$$= 10.40\ (H)^{.5}$$

Pipe = 20" Cast Iron
$A = \pi r^2 = 2.16$ Sq. Ft.
$g = 32.2$ Ft./sec
$C = 0.6$ King and Brater Handbook Pg 4-32 Table 4-6
H varies from 1.3 Ft. to 17.4 Ft. and is measured from the center of pipe at inlet = El. 987.7

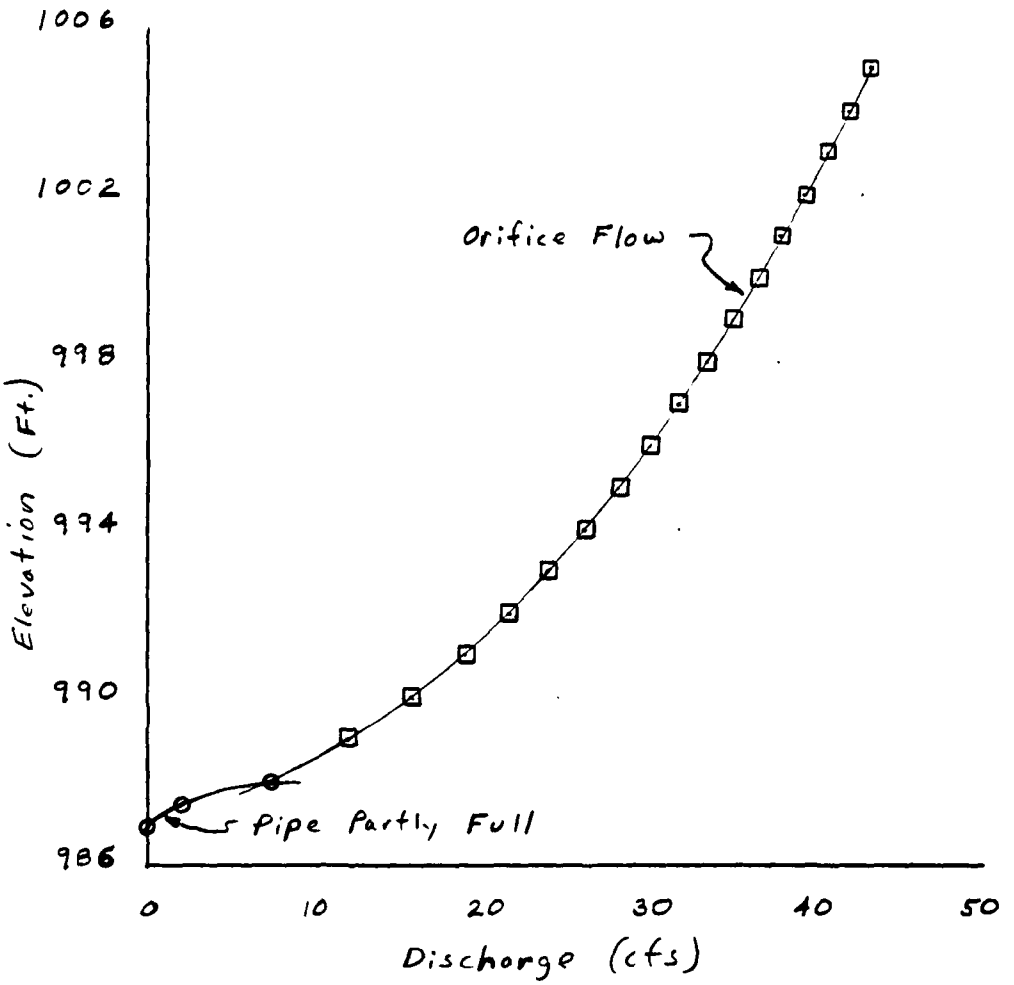
Elevation (Ft.)	H (Ft.)	Q (cfs)
989.0	1.3	11.9
990.0	2.3	15.8
991.0	3.3	18.9
992.0	4.3	21.6
993.0	5.3	23.9
994.0	6.3	26.1
995.0	7.3	28.1
996.0	8.3	30.0
997.0	9.3	31.7
998.0	10.3	33.4
999.0	11.3	35.0
1000.0	12.3	36.5
1001.0	13.3	37.9
1002.0	14.3	39.3
1003.0	15.3	40.7
1004.0	16.3	42.0
1005.1	17.4	43.4

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 18 of 37
20" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/81

RATING CURVE

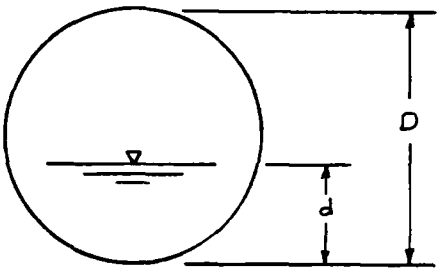


MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 19 of 37
12" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/81

Flow in Pipes Partly Full
"Design of Small Dams" Pages 558 and 559



D = Pipe Dia. = 12" = 1 Ft.
d = Depth of Flow
S = Slope = 0.0588
Pipe is Cast Iron
n = 0.014

$\frac{d}{D} = \frac{.4}{1.0} = .4$ $0.9103 = \frac{Q_c}{D^{5/2}} = \frac{Q_c}{(1)^{5/2}}$ $Q_c = 0.9$ cfs ✓

$\frac{d}{D} = \frac{.4}{1.0} = .4$ $0.1561 = \frac{Qn}{D^{8/3} S^{1/2}} = \frac{Q(0.014)}{(1)^{8/3}(.0588)^{1/2}}$ $Q = 2.7$ cfs ✓

$\frac{d}{D} = \frac{.7}{1.0} = .7$ $2.6656 = \frac{Q_c}{D^{5/2}} = \frac{Q_c}{(1)^{5/2}}$ $Q_c = 2.7$ cfs ✓

$\frac{d}{D} = \frac{.7}{1.0} = .7$ $0.388 = \frac{Qn}{D^{8/3} S^{1/2}} = \frac{Q(0.014)}{(1)^{8/3}(.0588)^{1/2}}$ $Q = 6.7$ cfs ✓

Critical Depth Controls

El. 986.9 $Q = 0$ ✓
El. 987.3 $Q = 0.9$ cfs ✓
El. 987.6 $Q = 2.7$ cfs ✓

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 20 of 37
12" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/81

Pipe Flow

$$Q = \frac{A(2gH)^{1/2}}{[1 + K_e + K_p(L)]^{1/2}}$$

$$= \frac{(0.79)(64.4\ H)^{1/2}}{[1 + .78 + 0.0363(170)]^{1/2}}$$

$$= 2.25\ (H)^{1/2}$$ ✓

Pipe = 12" Dia. Cast Iron
$A = \pi r^2 = 0.79$ Sq. Ft.
$g = 32.2$ Ft./sec.
$L = 170$ Ft.
Pipe Losses

Entrance Loss (K_e) = 0.78
Pg. 5.5-6 SCS NEH-5

Head Loss (K_p) = 0.0363
n = 0.014 Pg. 5.5-4
SCS NEH-5

H varies from 10.1 Ft. to 27.2 Ft. and is measured from the Top of Pipe at Outlet = El. 977.9

Elevation (Ft.)	H (Ft.)	Q (cfs)
988.0	10.1	7.2
989.0	11.1	7.5
990.0	12.1	7.8
991.0	13.1	8.1
992.0	14.1	8.4
993.0	15.1	8.7
994.0	16.1	9.0
995.0	17.1	9.3
996.0	18.1	9.6
997.0	19.1	9.8
998.0	20.1	10.1
999.0	21.1	10.3
1000.0	22.1	10.6
1001.0	23.1	10.8
1002.0	24.1	11.0
1003.0	25.1	11.3
1004.0	26.1	11.5
1005.1	27.2	11.7

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 21 of 37
12" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/81

Orifice Flow

$$Q = CA(2gH)^{.5}$$
$$= (.6)(0.79)(64.4\ H)^{.5}$$
$$= 3.80\ (H)^{.5}$$

Pipe = 12" Cast Iron
$A = \pi r^2 = 0.79$ Sq. Ft.
$g = 32.2$ Ft./sec.
$C = 0.6$ King and Brater Handbook Pg 4-32 Table 4-6
H varies from 0.6 Ft. to 17.7 Ft. and is measured from the center of pipe at inlet = El. 987.4

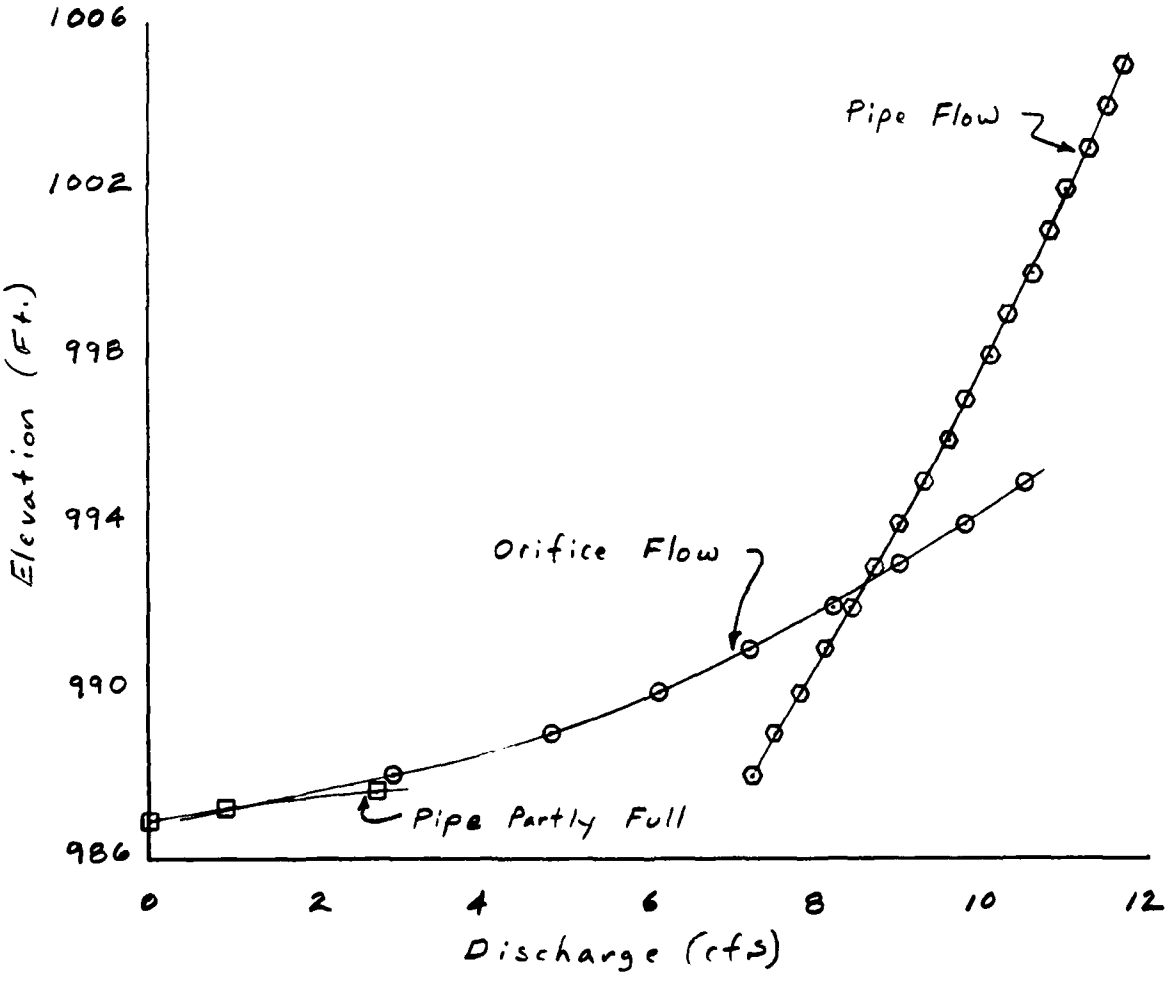
Elevation (Ft.)	H (Ft.)	Q (cfs)
988.0	0.6	2.9
989.0	1.6	4.8
990.0	2.6	6.1
991.0	3.6	7.2
992.0	4.6	8.2
993.0	5.6	9.0
994.0	6.6	9.8
995.0	7.6	10.5
996.0	8.6	11.2
1005.1	17.7	16.0

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 22 of 37
12" Pipe Rating Drawing No.
Computed by LAD Checked by JAQ Date 2/9/81

RATING CURVE



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject New York Dams S.O. No.
Earl Reservoir Dam Sheet No. 23 of 37
Outlet Summary Rating Drawing No.
Computed by LAD Checked by Date 2/9/81

Elevation (Ft.)	20" Pipe Q (cfs)	12" Pipe Q (cfs)	Total Q (cfs)
986.9	0	0	0
987.4	1.9	1.4	3.3
987.8	4.5	2.4	6.9
988.0	7.0	2.9	9.9
989.0	11.9	4.8	16.7
990.0	15.8	6.1	21.9
991.0	18.9	7.2	26.1
992.0	21.6	8.2	29.8
993.0	23.9	8.7	32.6
994.0	26.1	9.0	35.1
995.0	28.1	9.3	37.4
996.0	30.0	9.6	39.6
997.0	31.7	9.8	41.5
998.0	33.4	10.1	43.5
999.0	35.0	10.3	45.3
1000.0	36.5	10.6	47.1
1001.0	37.9	10.8	48.7
1002.0	39.3	11.0	50.3
1003.0	40.7	11.3	52.0
1004.0	42.0	11.5	53.5
1005.1	43.4	11.7	55.1

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
  HBJ UPDATE         04 JUN 79
**********
     1          A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
     2          A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF EARL RESERVOIR DAM
     3          A3       UNIT HYDROGRAPH BY SNYDERS METHOD
     4          B    300         0         5         0         0         0         0         0        -4         0
     5          B1         5
     6          J    1              4         1
     7          J1   1.0       0.75       0.5      0.25
     8          K                   1                                              1
     9          K1       RUNOFF HYDROGRAPH TO DAM
    10          M              1         1      0.70
    11          P                      21.6       111       123       133       142                                1
    12          T                                                                          1.0       0.1
    13          W    1.80       0.63
    14          X   -1.0      -0.05         2
    15          K              1         2                                              1
    16          K1       ROUTING FOR EARL RESERVOIR DAM
    17          Y                                              1         1
    18          Y1             1                                                   -1005.1        -1
    19          Y41005.1  1006.1    1007.1    1008.1    1009.1    1010.1    1011.1    1012.1    1013.1
    20          Y5             0     375.1    1135.6    2126.3    3035.5    3206.3    3364.6    3517.6    3669.2
    21          $A             0       1.6      16.0      21.5      24.8      49.6
    22          $E  986.9   989.1    1005.1    1008.9    1012.1    1032.1
    23          $$1005.1
    24          $01007.9       2.6       1.5
    25          $L             0        17        36       489       549       651       750
    26          $V1007.9  1008.2    1008.9    1009.0    1010.0    1012.0    1014.0
    27          K             99
```

SHEET 24 of 37

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
END OF NETWORK

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  NBJ UPDATE         04 JUN 79
**********

RUN  DATE 02/10/81
     TIME    14.57
```

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF EARL RESERVOIR DAM
UNIT HYDROGRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NRR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
500	0	5	0	0	0	0	0	-4	0
			JOPER	NRT	LROPT	TRACE			
			5	0	0	0	0		

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 0.75 0.50 0.25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	0.70	0.0	0.70	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	21.60	111.00	123.00	133.00	142.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.10	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 1.80 CP=0.63 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 130 END-OF-PERIOD ORDINATES, LAG= 1.80 HOURS, CP= 0.63 VOL= 0.99

2.	9.	13.	21.	30.	40.	50.	60.	72.	83.
95.	107.	118.	128.	137.	145.	152.	157.	161.	163.
165.	164.	162.	157.	150.	143.	136.	129.	122.	116.
111.	106.	100.	95.	90.	86.	82.	78.	74.	70.

SHEET 26 of 37

67.	63.	60.	57.	54.	52.	49.	47.	44.	42.	
40.	38.	36.	34.	33.	31.	30.	28.	27.	25.	
24.	23.	22.	21.	20.	19.	18.	17.	16.	15.	
15.	14.	13.	12.	12.	11.	11.	10.	10.	9.	
9.	8.	8.	8.	7.	7.	6.	6.	6.	6.	
5.	5.	5.	5.	4.	4.	4.	4.	4.	3.	

END-OF-PERIOD FLOW

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.34	20.82	3.71	41061.
										623.11	529.11	94.11	3120.13

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING FOR EARL RESERVOIR DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

JLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1005.	-1

STAGE	1005.10	1006.10	1007.10	1008.10	1009.10	1010.10	1011.10	1012.10	1013.10
FLOW	0.0	375.10	1135.60	2126.30	3035.50	3204.30	3304.60	3517.60	3669.20
SURFACE AREA=	0.	2.	16.	22.	25.	50.			
CAPACITY=	0.	1.	122.	193.	267.	997.			
ELEVATION=	987.	989.	1005.	1009.	1012.	1032.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1005.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1007.9	2.6	1.5	0.

CREST LENGTH AT OR BELOW ELEVATION	0. 1007.9	17. 1008.2	36. 1008.9	489. 1009.0	549. 1010.0	651. 1012.0	750. 1014.0

PEAK OUTFLOW IS 1778. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 1333. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 883. AT TIME 41.58 HOURS

PEAK OUTFLOW IS 435. AT TIME 41.67 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4
				RATIOS APPLIED TO FLOWS			
				1.00	0.75	0.50	0.25
HYDROGRAPH AT	1	3.70	1	1810.	1357.	905.	454.
	(	1.81)	(	51.25)(	38.43)(	25.62)(	12.81)(
ROUTED TO	2	3.70	1	1778.	1333.	883.	435.
	(	1.81)	(	50.35)(	37.75)(	24.99)(	12.31)(

SHEET 28 OF 37

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1005.10	1005.10	1007.90
STORAGE	122.	122.	172.
OUTFLOW	0.	0.	1928.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1007.75	0.0	169.	1778.	0.0	41.50	0.0
0.75	1007.30	0.0	161.	1333.	0.0	41.50	0.0
0.50	1006.77	0.0	151.	883.	0.0	41.58	0.0
0.25	1006.18	0.0	140.	435.	0.0	41.67	0.0

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1973
  LAST MODIFICATION  26 FEB 79
  MAJ UPDATE         04 JUN 79
**********
     1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
     2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF EARL RESERVOIR DAM
     3              A3       DEWATERING ANALYSIS OF EARL RESERVOIR DAM
     4              B    10J       1         0         0         0         0         0         0         0         0
     5              B1    5
     6              J     1         1         1
     7              J1  1.0
     8              K     0         1                                                 1
     9              K1       NULL RUNOFF HYDROGRAPH TO DAM
    10              M    -1                  0.70                0.70                                        1
    11              N
    12              N
    13              N
    14              N
    15              N
    16              N
    17              N
    18              N
    19              N
    20              N
    21              K     1         2                                                 1
    22              K1       DEWATERING EARL RESERVOIR
    23              Y                                           1         1
    24              Y1    1                                                   -1005.1        -1
    25              Y4 986.3    987.4     987.8     988.0     989.0     990.0     992.0     994.0     996.0     998.0
    26              Y41000.3   1002.3    1004.0    1005.1
    27              Y5    J     3.3       6.9       9.9      16.7      21.9      29.8      35.1      39.6      43.5
    28              Y5  47.1    50.3      53.5      55.1
    29              $A    J     1.0      16.0      21.5      24.8      49.6
    30              $E 986.3    989.1    1005.1    1008.9    1012.1    1032.1
    31              $$1005.1
    32              $D1007.3      2.6       1.5
    33              K    99
```

SHEET 30 of 97

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT        1
ROUTE HYDROGRAPH TO         2
END OF NETWORK
```

SHEET 32 of 37

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION   26 FEB 79
  MBJ UPDATE          04 JUN 79
**********************************

RUN  DATE 02/10/81
     TIME    15.05

                    NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
                    HYDROLOGIC AND HYDRAULIC ANALYSIS OF EARL RESERVOIR DAM
                    DEWATERING ANALYSIS OF EARL RESERVOIR DAM

                                       JOB SPECIFICATION
          NQ      NHR     NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
         100        1        0       0       0       0       0       0       0       0
                                 JOPER     NWT   LROPT   TRACE
                                     5       0       0       0       0

                                  MULTI-PLAN ANALYSES TO BE PERFORMED
                                  NPLAN= 1 NRTIO= 1 LRTIO= 1
          RTIOS=   1.00

      **********          **********          **********          **********          **********

                                  SUB-AREA RUNOFF COMPUTATION

          NULL RUNOFF HYDROGRAPH TO DAM

                       ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                           1       0       0       0       0       0       1       0       0

                                        HYDROGRAPH DATA
         IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
            -1       0    0.70     0.0    0.70     0.0     0.0       0       1       0

                                        INPUT HYDROGRAPH
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

                 PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
         CFS       0.        0.        0.        0.             0.
         CMS       0.        0.        0.        0.             0.
      INCHES                0.0       0.0       0.0            0.0
          MM                0.0       0.0       0.0            0.0
       AC-FT                 0.        0.        0.             0.
   THOUS CU M                0.        0.        0.             0.
```

1.01	2.00	2	2.00	0.	54.	113.	1004.3
1.01	3.00	3	3.00	0.	54.	109.	1004.2
1.01	4.00	4	4.00	0.	53.	104.	1003.9
1.01	5.00	5	5.00	0.	53.	100.	1003.6
1.01	6.00	6	6.00	0.	52.	95.	1003.3
1.01	7.00	7	7.00	0.	52.	91.	1003.0
1.01	8.00	8	8.00	0.	51.	87.	1002.6
1.01	9.00	9	9.00	0.	51.	83.	1002.3
1.01	10.00	10	10.00	0.	50.	78.	1002.0
1.01	11.00	11	11.00	0.	50.	74.	1001.6
1.01	12.00	12	12.00	0.	49.	70.	1001.3
1.01	13.00	13	13.00	0.	49.	66.	1000.9
1.01	14.00	14	14.00	0.	48.	62.	1000.5
1.01	15.00	15	15.00	0.	47.	58.	1000.2
1.01	16.00	16	16.00	0.	47.	54.	999.7
1.01	17.00	17	17.00	0.	46.	50.	999.3
1.01	18.00	18	18.00	0.	45.	47.	998.9
1.01	19.00	19	19.00	0.	44.	43.	998.5
1.01	20.00	20	20.00	0.	43.	39.	998.0
1.01	21.00	21	21.00	0.	43.	36.	997.5
1.01	22.00	22	22.00	0.	42.	32.	997.0
1.01	23.00	23	23.00	0.	41.	29.	996.5
1.02	0.0	24	24.00	0.	40.	26.	996.0
1.02	1.00	25	25.00	0.	38.	22.	995.4
1.02	2.00	26	26.00	0.	37.	19.	994.8
1.02	3.00	27	27.00	0.	36.	16.	994.2
1.02	4.00	28	28.00	0.	34.	13.	993.6
1.02	5.00	29	29.00	0.	32.	11.	992.8
1.02	6.00	30	30.00	0.	30.	8.	992.1
1.02	7.00	31	31.00	0.	27.	6.	991.3
1.02	8.00	32	32.00	0.	24.	4.	990.4
1.02	9.00	33	33.00	0.	20.	2.	989.5
1.02	10.00	34	34.00	0.	14.	1.	988.6
1.02	11.00	35	35.00	0.	0.	0.	986.9
1.02	12.00	36	36.00	0.	0.	0.	986.9
1.02	13.00	37	37.00	0.	0.	0.	986.9
1.02	14.00	38	38.00	0.	0.	0.	986.9
1.02	15.00	39	39.00	0.	0.	0.	986.9
1.02	16.00	40	40.00	0.	0.	0.	986.9
1.02	17.00	41	41.00	0.	0.	0.	986.9
1.02	18.00	42	42.00	0.	0.	0.	986.9
1.02	19.00	43	43.00	0.	0.	0.	986.9
1.02	20.00	44	44.00	0.	0.	0.	986.9
1.02	21.00	45	45.00	0.	0.	0.	986.9
1.02	22.00	46	46.00	0.	0.	0.	986.9
1.02	23.00	47	47.00	0.	0.	0.	986.9
1.03	0.0	48	48.00	0.	0.	0.	986.9
1.03	1.00	49	49.00	0.	0.	0.	986.9
1.03	2.00	50	50.00	0.	0.	0.	986.9
1.03	3.00	51	51.00	0.	0.	0.	986.9
1.03	4.00	52	52.00	0.	0.	0.	986.9
1.03	5.00	53	53.00	0.	0.	0.	986.9
1.03	6.00	54	54.00	0.	0.	0.	986.9
1.03	7.00	55	55.00	0.	0.	0.	986.9
1.03	8.00	56	56.00	0.	0.	0.	986.9
1.03	9.00	57	57.00	0.	0.	0.	986.9
1.03	10.00	58	58.00	0.	0.	0.	986.9
1.03	11.00	59	59.00	0.	0.	0.	986.9
1.03	12.00	60	60.00	0.	0.	0.	986.9
1.03	13.00	61	61.00	0.	0.	0.	986.9
1.03	14.00	62	62.00	0.	0.	0.	986.9
1.03	15.00	63	63.00	0.	0.	0.	986.9
1.03	16.00	64	64.00	0.	0.	0.	986.9
1.03	17.00	65	65.00	0.	0.	0.	986.9
1.03	18.00	66	66.00	0.	0.	0.	986.9
1.03	19.00	67	67.00	0.	0.	0.	986.9

1.03	20.00	68	68.00	0.	0.	0.	986.9
1.03	21.00	69	69.00	0.	0.	0.	986.9
1.03	22.00	70	70.00	0.	0.	0.	986.9
1.03	23.00	71	71.00	0.	0.	0.	986.9
1.04	0.0	72	72.00	0.	0.	0.	986.9
1.04	1.00	73	73.00	0.	0.	0.	986.9
1.04	2.00	74	74.00	0.	0.	0.	986.9
1.04	3.00	75	75.00	0.	0.	0.	986.9
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1.04	22.00	94	94.00	0.	0.	0.	986.9
1.04	23.00	95	95.00	0.	0.	0.	986.9
1.05	0.0	96	96.00	0.	0.	0.	986.9
1.05	1.00	97	97.00	0.	0.	0.	986.9
1.05	2.00	98	98.00	0.	0.	0.	986.9
1.05	3.00	99	99.00	0.	0.	0.	986.9
1.05	4.00	100	100.00	0.	0.	0.	986.9

PEAK OUTFLOW IS 55. AT TIME 0.0 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	55.	53.	48.	20.	1422.
CMS	2.	2.	1.	1.	40.
INCHES		0.71	2.55	3.15	3.15
MM		18.00	64.69	79.98	79.98
AC-FT		26.	95.	117.	117.
THUUS CU M		33.	117.	145.	145.

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	1	0.73	1	0.
	(	1.81)	(	0.0)(
ROUTED TO	2	0.73	1	55.
	(	1.81)	(	1.55)(

SHEET 38 OF 137

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1005.10	1005.10	1007.90
STORAGE	122.	122.	172.
OUTFLOW	55.	55.	59.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1004.81	0.0	122.	55.	0.0	0.6	0.0

APPENDIX D

REFERENCES

REFERENCES

1. University of the State of New York, Geology of New York, Education Leaflet 20, 1966.

2. Broughton, John G. and others, "Geologic Map of New York - Lower Hudson Sheet," New York State Museum and Science Service, Map and Chart Series No. 15, 1970.

3. Soil Conservation Service, Soil Interpretations Inventory Analysis and Erosion Control - Orange County, New York, U.S. Dept. of Agriculture, January 1972.

4. Dunbar, Carl O. and Waage, Karl M., Historical Geology, John Wiley and Sons, Inc., New York, 1969.

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9. King, Horace Williams and Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, McGraw - Hill Book Company, New York, 1963.

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12. U.S. Army, Hydrological Engineering Center, "Flood Hydrograph Package (HEC-1), Dam Safety Investigations, Users Manual," Corps of Engineers, Davis, California, September 1978.

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14. U.S. Army, "Inventory of United States Dams," Corps of Engineers, 9 September 1978.

15. U.S. Army, Office of the Chief of Engineers, "Appendix D, Recommended Guidelines for Safety Inspection of Dams," National Program of Inspection of Dams, Volume 1, Corps of Engineers, Washington, D.C., May 1975.

16. George, Thomas S. and Taylor, Robert S., Hydrologic Flood Routing Model For Lower Hudson River Basin, Water Resources Engineers, Inc., 8001 Forbes Place, Suite 312, Springfield, Virginia, January 1977.

17. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-163 (Draft Engineering Manual), "Spillway and Freeboard Requirements for Dams, Appendix C, Hydrometeorological Criteria and Hyetograph Estimates," (August 1975).

18. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-188, "Engineering and Design, National Program of Inspection of Non-Federal Dams," Corps of Engineers, Washington, D.C., 30 December 1977.

19. U.S. Army, Office of the Chief of Engineers, Engineer Technical Letter No. ETL 1110-2-234, "Engineering and Design, National Program of Inspection of Non-Federal Dams, Review of Spillway Adequacy," Corps of Engineers, Washington, D.C., 10 May 1978.

20. U.S. Department of Commerce, "Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," Weather Bureau, Washington, D.C., May 1961.

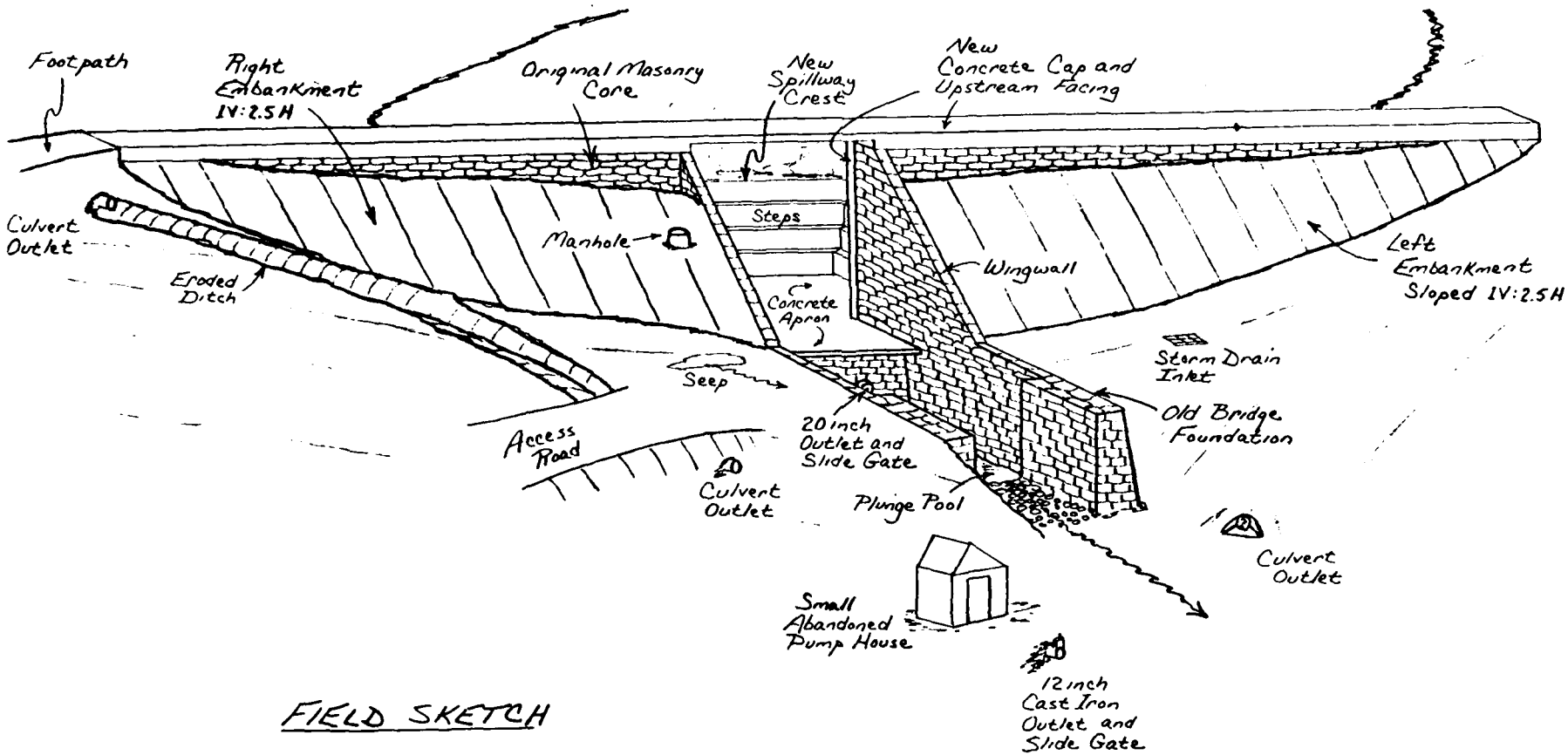
21. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, "Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Washington, D.C., June 1978.

APPENDIX E

DRAWINGS AND ENGINEER'S REPORT

CONTENTS

-Not to Scale-



FIELD SKETCH

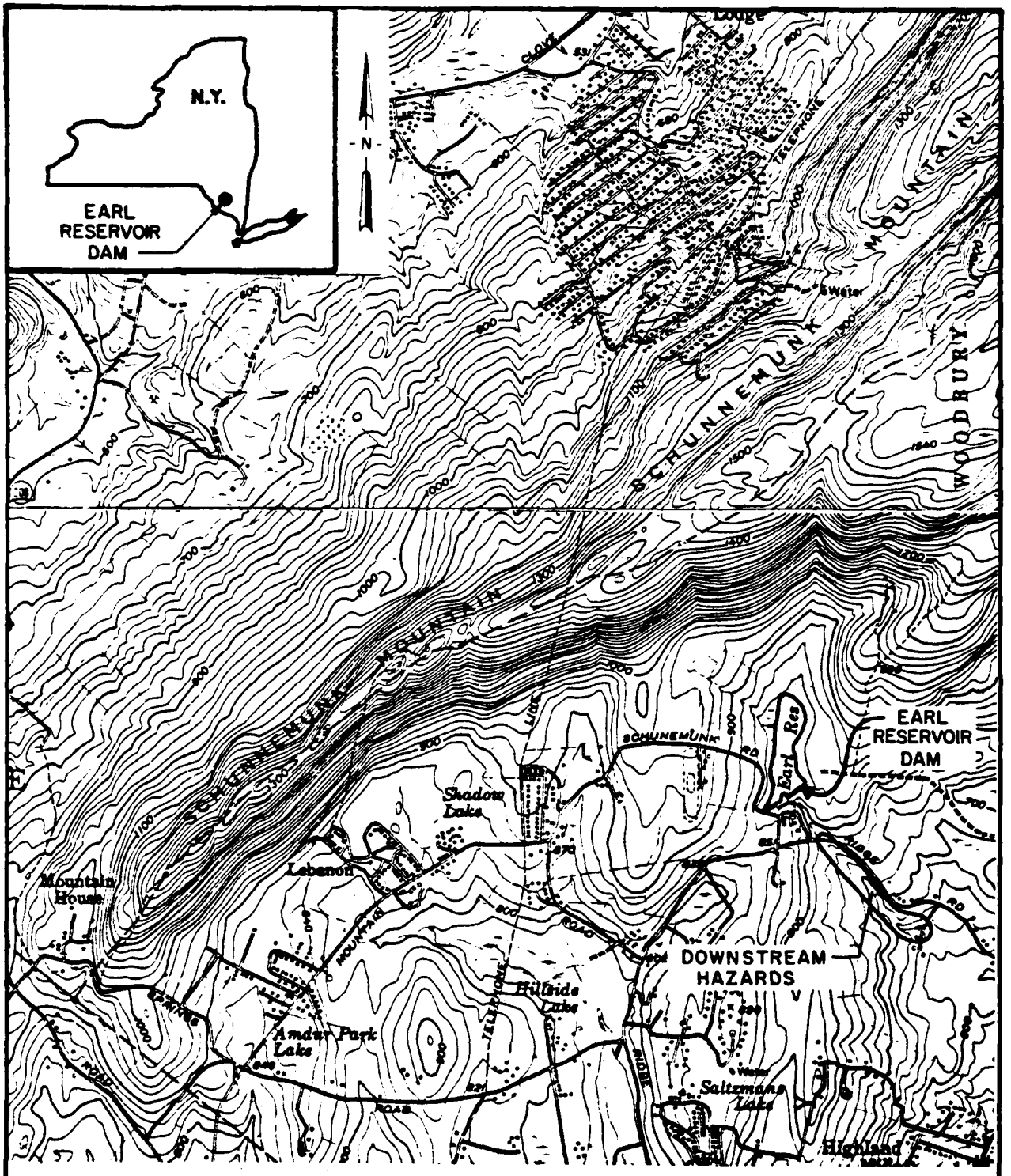
EARL RESERVOIR DAM, NEW YORK

Michael Baker, Jr., Inc.

9 January 1981

PLATE 1

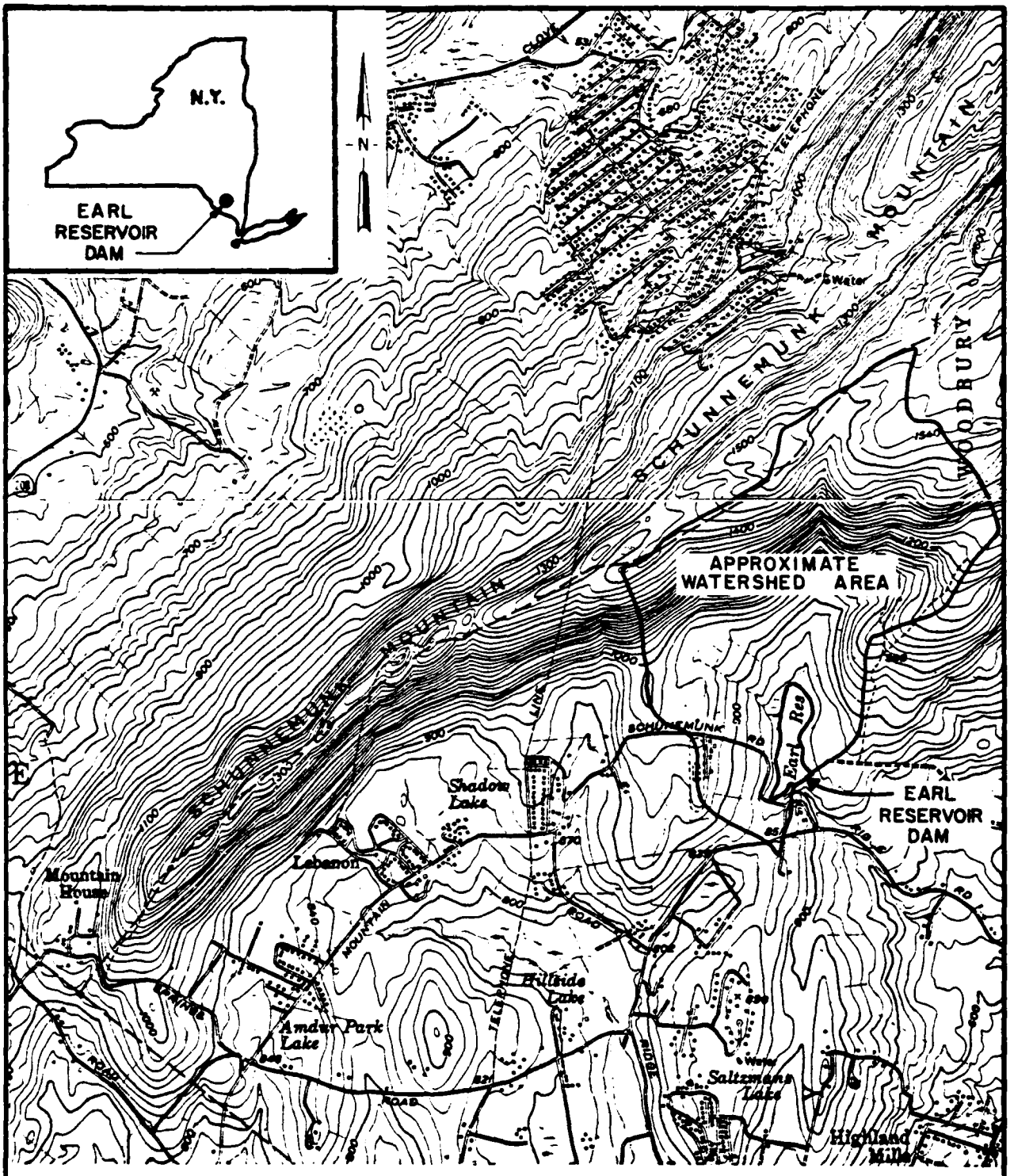
DWH 1-81



REFERENCES:
1. U.S.G.S. 7.5' MAYBROOK, N.Y. QUADRANGLE. 1957
2. U.S.G.S. 7.5' MONROE, N.Y. QUADRANGLE. 1957

LOCATION PLAN

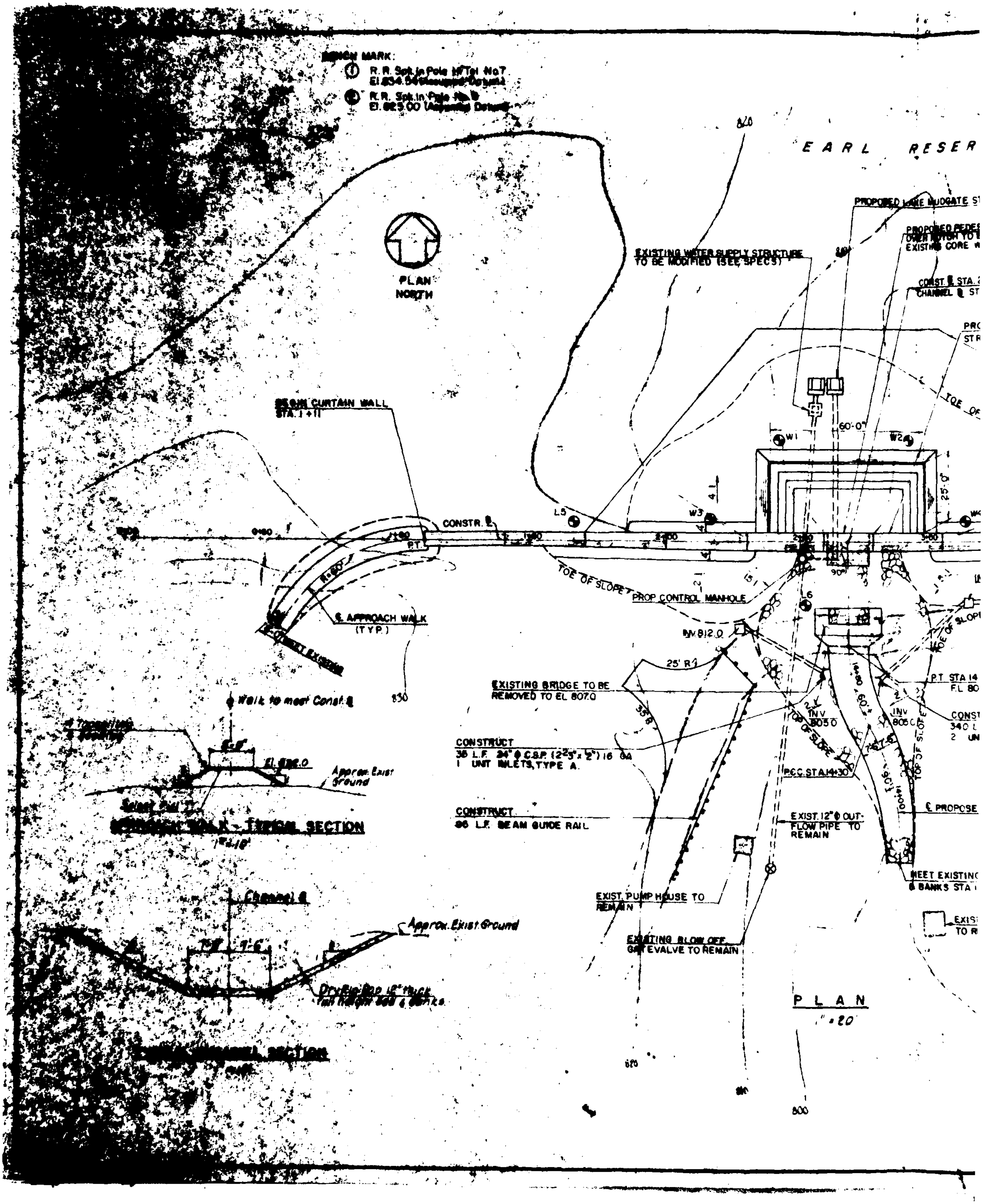
EARL RESERVOIR DAM



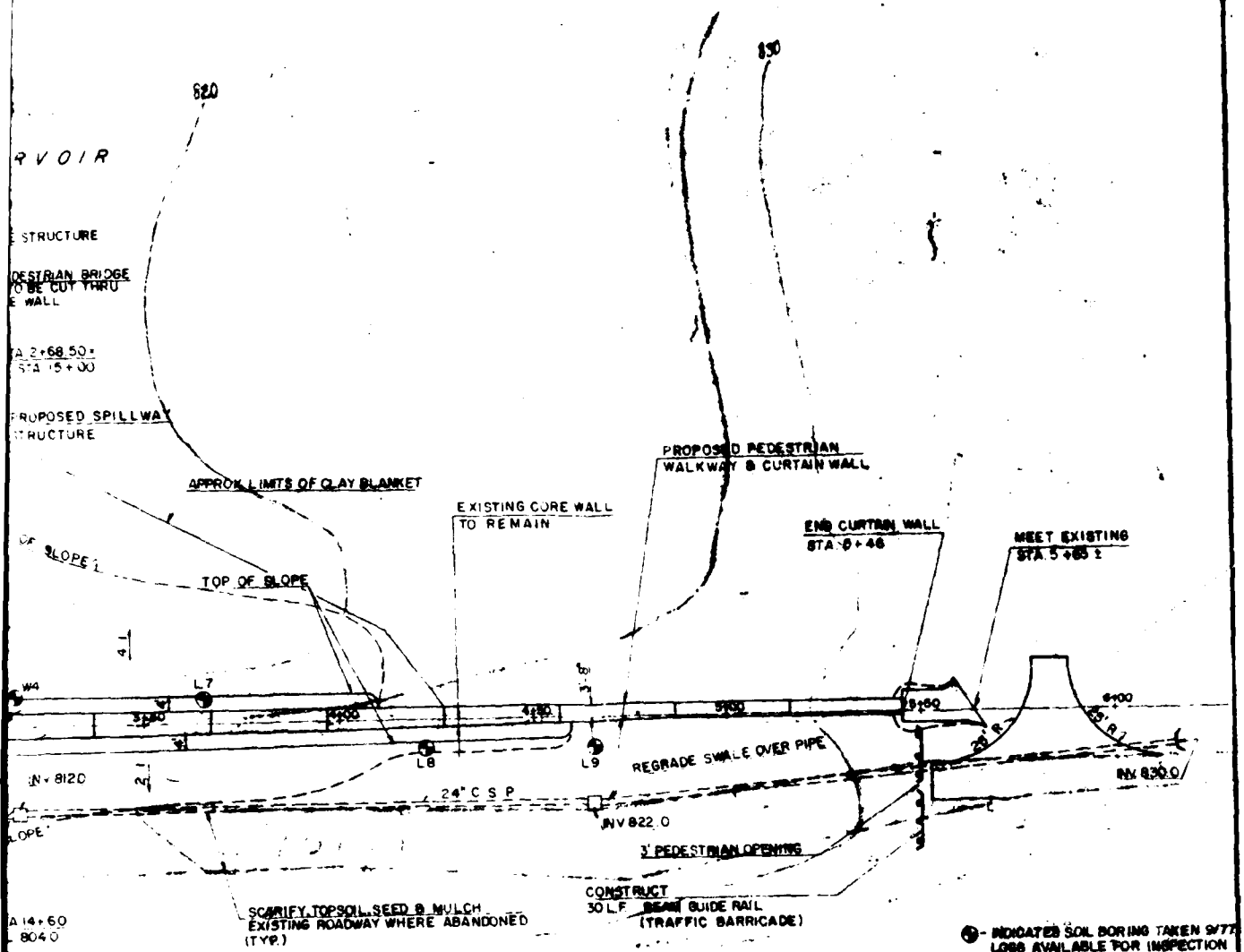
REFERENCES:
1. U.S.G.S. 7.5' MAYBROOK, N.Y. QUADRANGLE. 1957
2. U.S.G.S. 7.5' MONROE, N.Y. QUADRANGLE. 1957

WATERSHED MAP

EARL RESERVOIR DAM



R.R. Spk.in Pole
R.R. Spk.in Pole
El. 825.00
PLAN NORTH
EARL RESER
PROPOSED LAKE MUDGATE ST
EXISTING WATER SUPPLY STRUCTURE TO BE MODIFIED (SEE SPECS)
EXISTING CORE W
CONST. STA.
CHANNEL STA.
BEGIN CURTAIN WALL STA. 1+11
60'-0"
W1
W2
W3
L5
L6
25'-0"
CONSTR.
P.T.
TOE OF SLOPE
PROP. CONTROL MANHOLE
APPROACH WALK (TYP.)
INV. 812.0
25' R
EXISTING BRIDGE TO BE REMOVED TO EL 807.0
Walk to meet Const.
El. 826.0
Approx. Exist Ground
Select Fill
APPROACH WALK - TYPICAL SECTION
CONSTRUCT
38 L.F. 24" CSP (2 2/3" x 1/2") 16 GA
1 UNIT INLETS, TYPE A.
CONSTRUCT
96 L.F. BEAM GUIDE RAIL
INV 805.0
INV 805.0
TOE OF SLOPE
P.C.C. STA.14+30
P.T. STA 14
CONST
EXIST. 12" OUT-FLOW PIPE TO REMAIN
PROPOSE
MEET EXISTING BANKS STA
EXIST. PUMP HOUSE TO REMAIN
EXISTING BLOW OFF GATE VALVE TO REMAIN
Channel
Approx. Exist Ground
PLAN
1" = 20'
820
830
800



Notes:
1. Existing information is not guaranteed to be correct. Bidders shall visit the site to determine the extent of the work. Dimensions shall be field verified.
2. For Details of Clay Blanket, see Sheet 11.

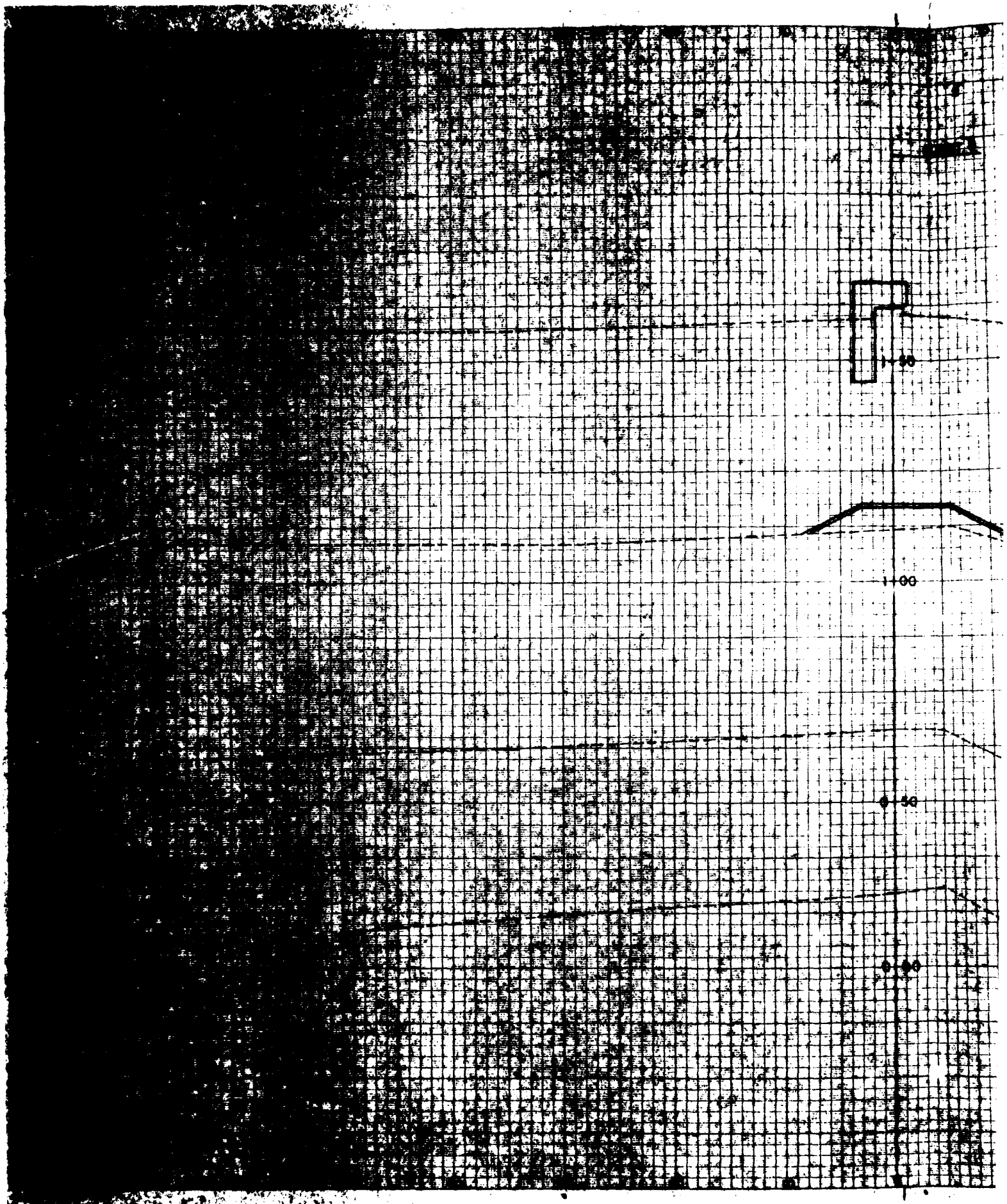
PLATE 2

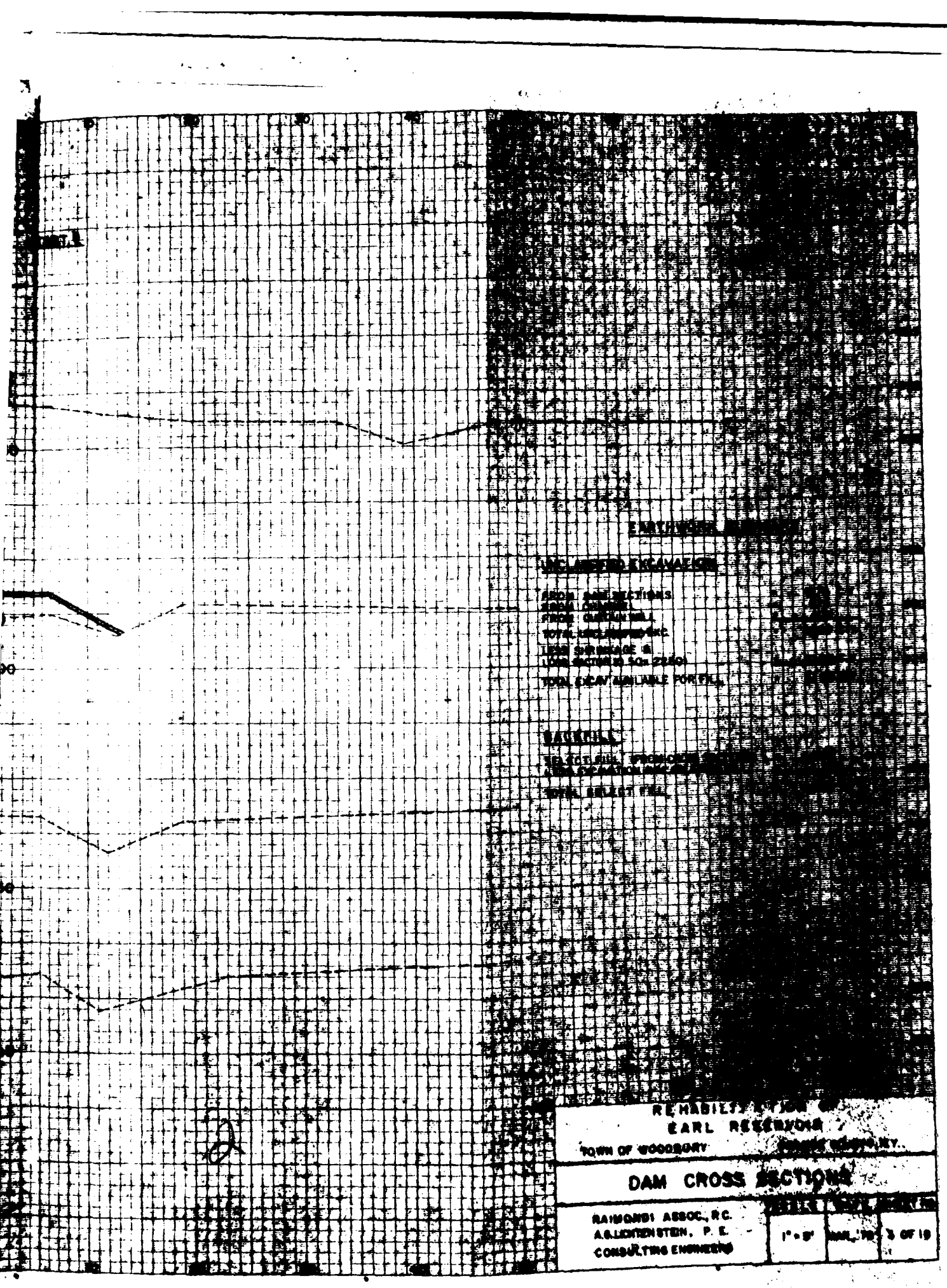
REHABILITATION OF EARL RESERVOIR

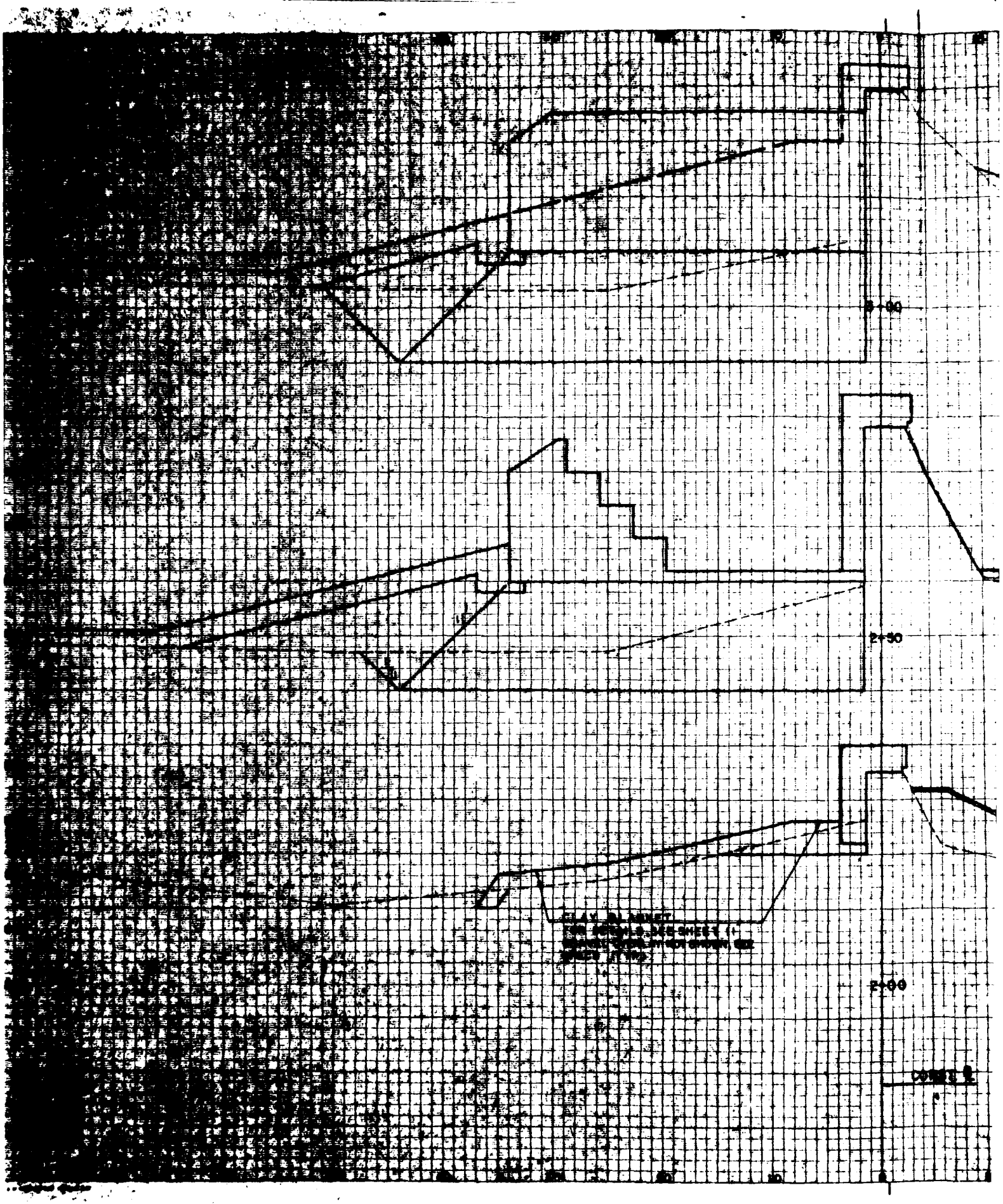
TOWN OF WOODBURY — ORANGE COUNTY, N.Y.

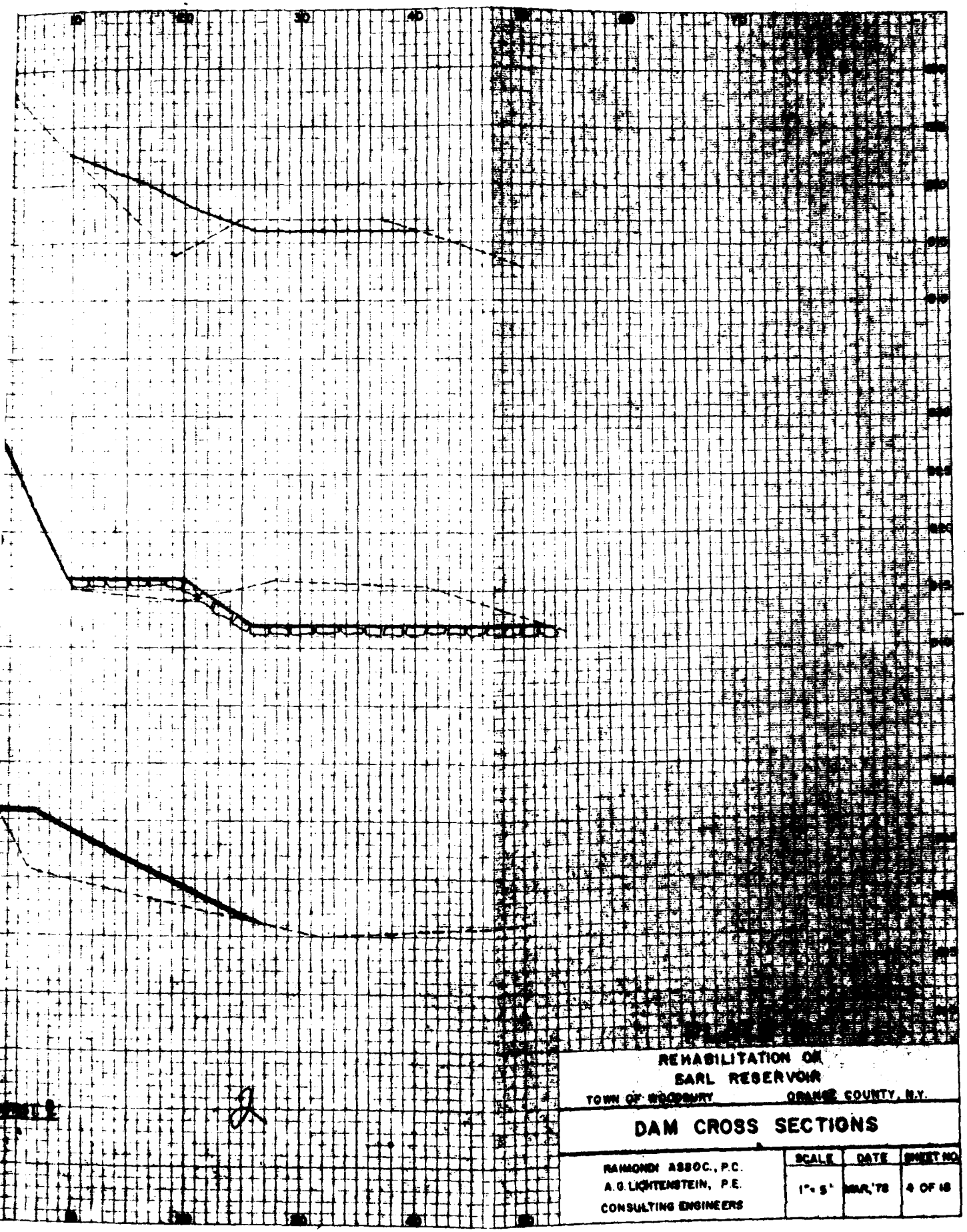
PLAN

RAIMONDI ASSOC., P.C. A.G. LICHTENSTEIN, P.E. CONSULTING ENGINEERS	SCALE	DATE	SHEET NO.
	AS SHOWN	MAR., '78	2 OF 18


1·50
1·00
0·50
0·00


EARTHWORK
UNCLASSIFIED EXCAVATION
FROM CUT SECTIONS
FROM CHANNEL
FROM CUTOFF WALL
TOTAL UNCLASSIFIED EXC.
LESS SURCHARGE @
LESS SECTION B SQ= 22401
TOTAL EXCAV AVAILABLE FOR FILL
BACKFILL
TOTAL SELECT FILL
REHABILITATION OF
EARL RESERVOIR
TOWN OF WOODBURY
DAM CROSS SECTIONS
RAIMONDI ASSOC., P.C.
A.S. LICHTENSTEIN, P.E.
CONSULTING ENGINEERS
1" = 5'
MAR. '82
3 OF 19

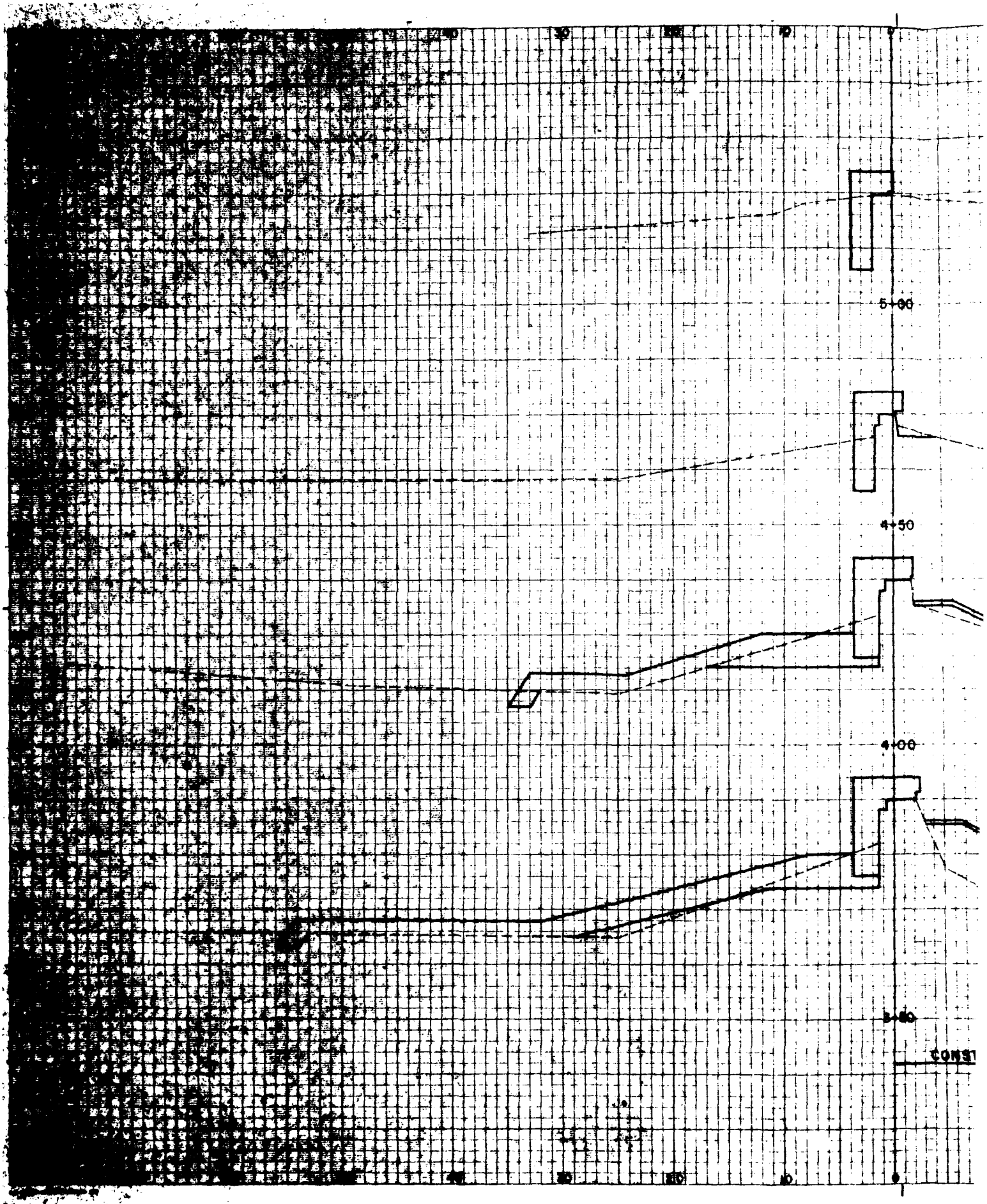

3+00
2+50
2+00

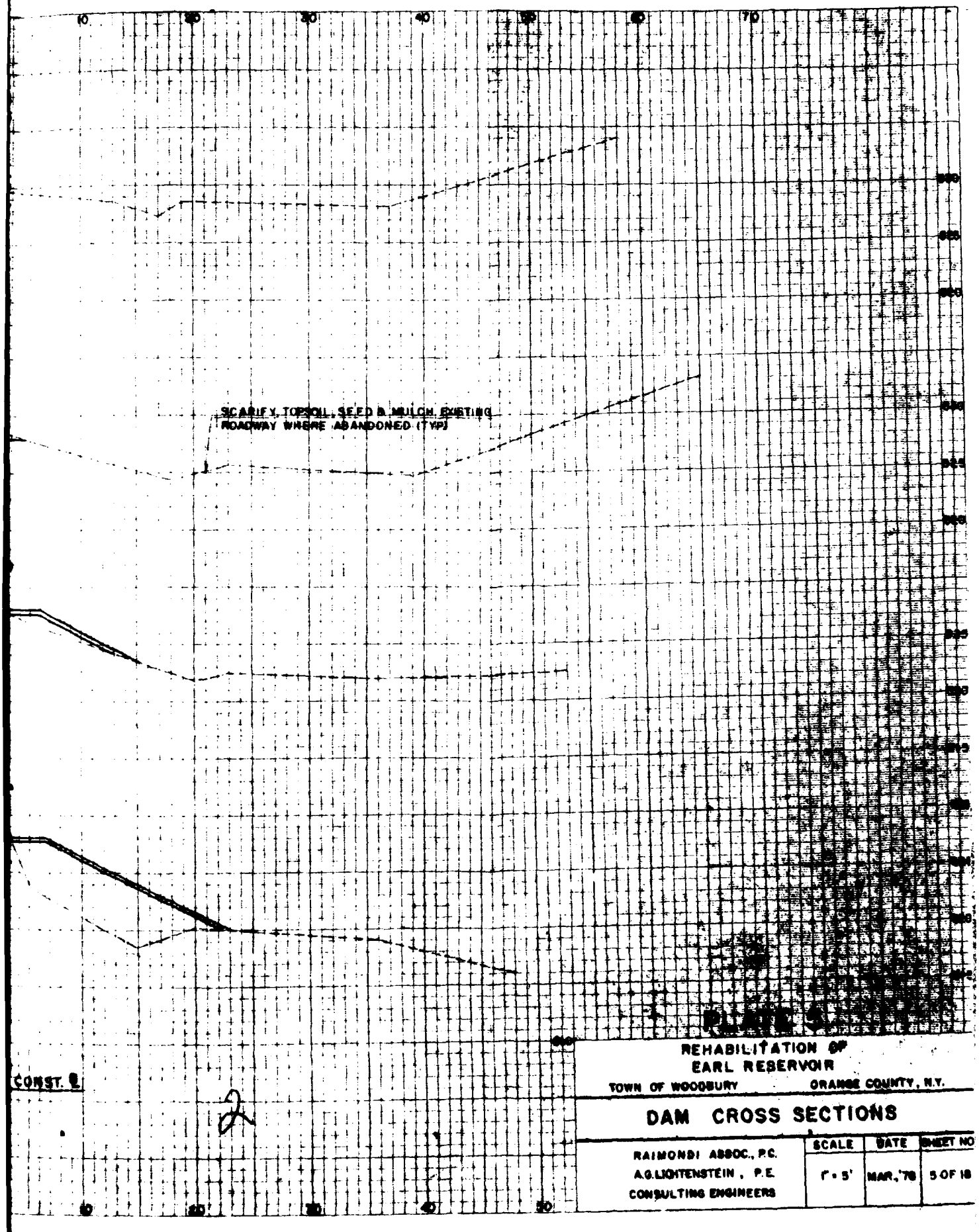


REHABILITATION OF
SARL RESERVOIR
TOWN OF WOODBURY ORANGE COUNTY, N.Y.

DAM CROSS SECTIONS

	SCALE	DATE	SHEET NO.
RAIMONDI ASSOC., P.C. A. G. LICHTENSTEIN, P.E. CONSULTING ENGINEERS	1"= 5'	MAR.'78	4 OF 18


5+00
4+50
4+00
CONST

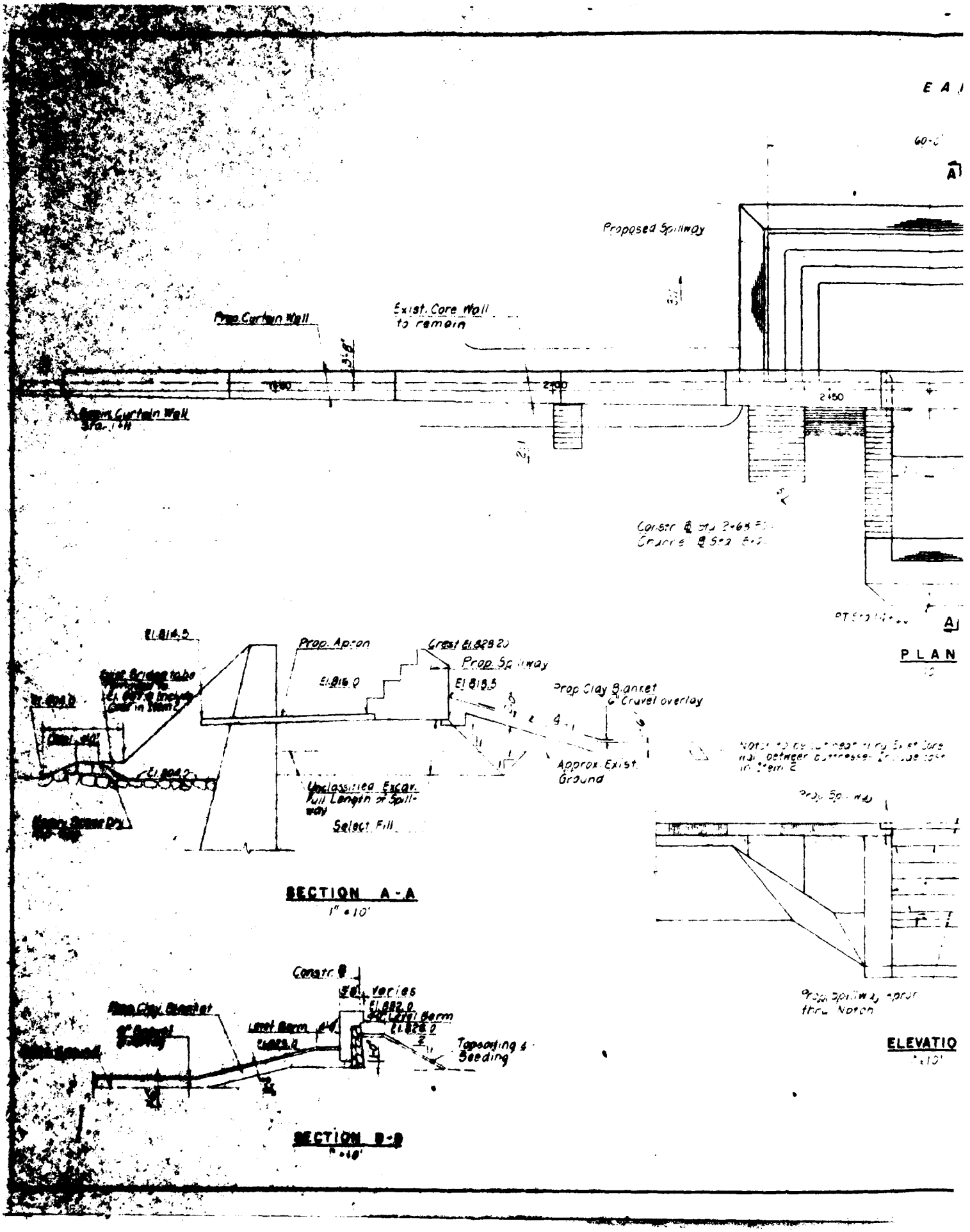


CONST. E

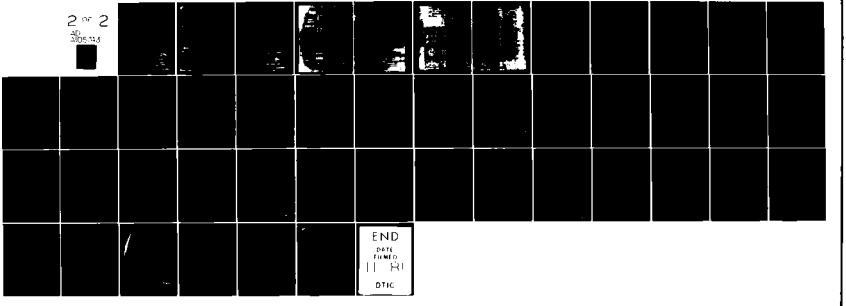
REHABILITATION OF
EARL RESERVOIR
TOWN OF WOODBURY ORANGE COUNTY, N.Y.

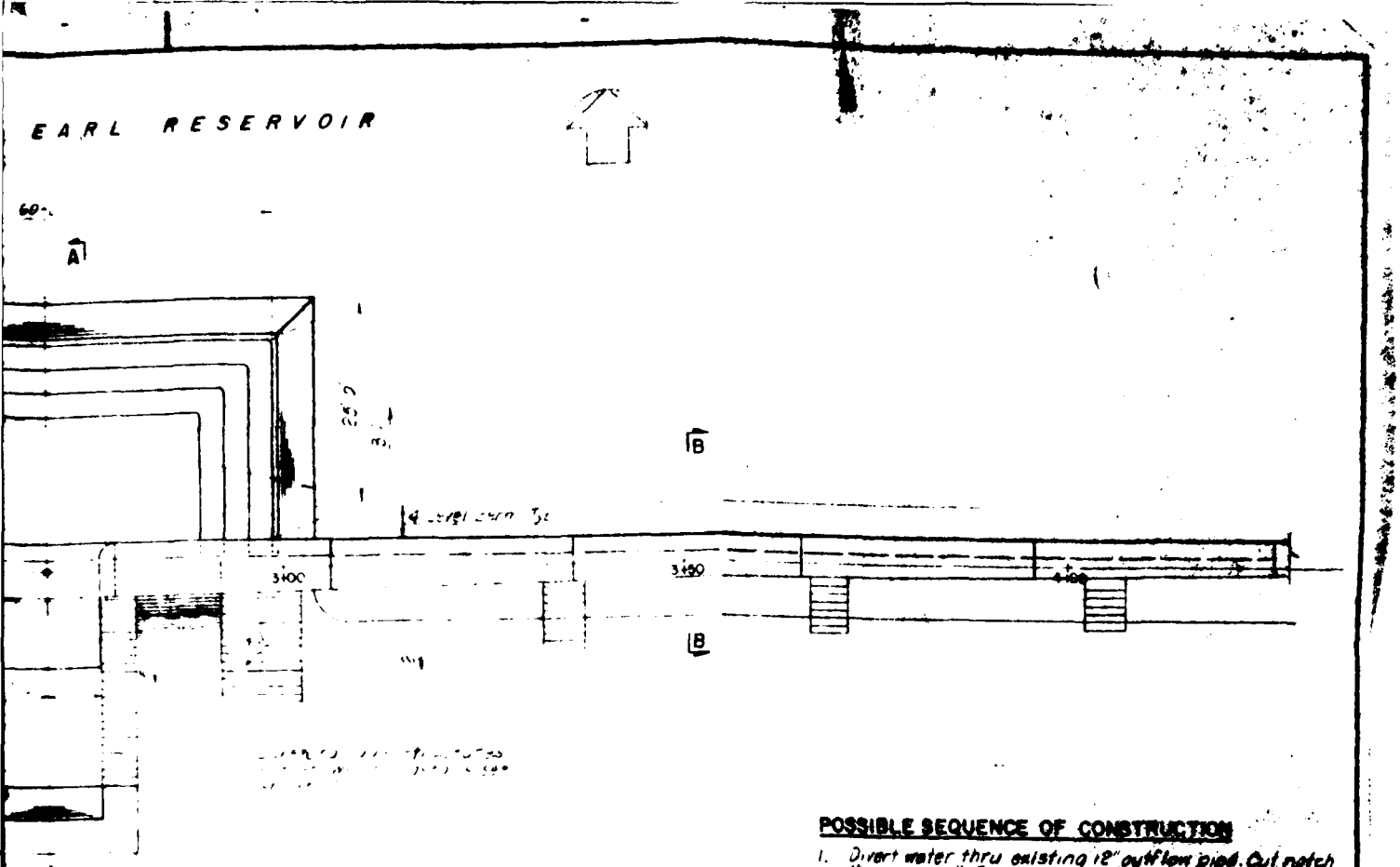
DAM CROSS SECTIONS

	SCALE	DATE	SHEET NO
RAIMONDI ASSOC., P.C. A.G.LICHTENSTEIN, P.E. CONSULTING ENGINEERS	1" = 5'	MAR.,'78	5 OF 18

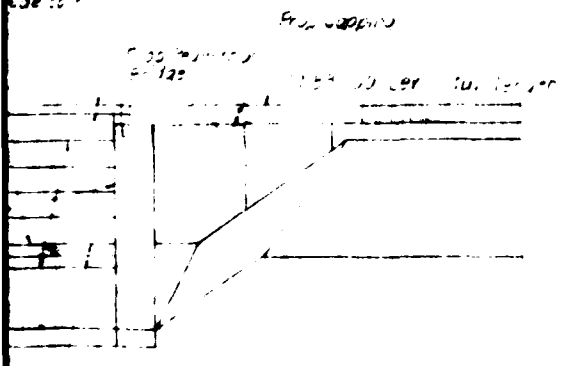

Proposed Spillway
Prop. Curtain Wall
Exist. Core Wall to remain
Prop. Curtain Wall
1+80
2+00
2+50
PLAN
El. 814.5
Prop. Apron
Crest El. 829.20
Prop. Spillway
El. 816.0
El. 818.5
Prop. Clay Blanket
6" Gravel overlay
Approx. Exist. Ground
Unclassified Excav. Full Length of Spillway
Select Fill
SECTION A-A
1" = 10'
Prop. Spillway
Prop. Spillway apron thru Apron
ELEVATIO
Constr. ℄
50'
varies
El. 832.0
Inlet Berm
El. 828.0
Topsoiling & Seeding
SECTION B-B

AD-A105 743 BAKER (MICHAEL) JR INC BEAVER PA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. EARL RESERVOIR DAM (INVENTORY NUMB--ETC(U)
JUN 81 G KESTER DACW51-81-C-0010
UNCLASSIFIED NL





PLAN



ELEVATION

POSSIBLE SEQUENCE OF CONSTRUCTION

1. Divert water thru existing 12" outflow pipe. Cut notch thru cornwall. Excavate unsuitable material under proposed spillway. Remove existing mudgate valve. Partially backfill excavation. Construct & encase new mudgate structure.
2. Divert water thru mudgate structure. Reconnect existing 12" Main. (A gap for the 12" Main will be kept available in place of right in case of heavy rain.)
3. Divert water thru both the 12" Main & the mudgate & complete backfill under proposed spillway.
4. Construct Spillway, Apron & Curtain Wall
5. Construct Pedestrian Bridge & Railing.
6. Complete Embankment, Clay Blanket & Channel work. Remove existing bridge.
7. Complete Miscellaneous Work.

Notes:

1. This sequence of construction is suggested but does not in any way limit the contractor to his selected method of [illegible]. Contractor shall submit his [illegible] of construction to the [illegible] before start of construction for approval.
2. Pedestrian & Vehicular traffic to be [illegible]

PLATE 2

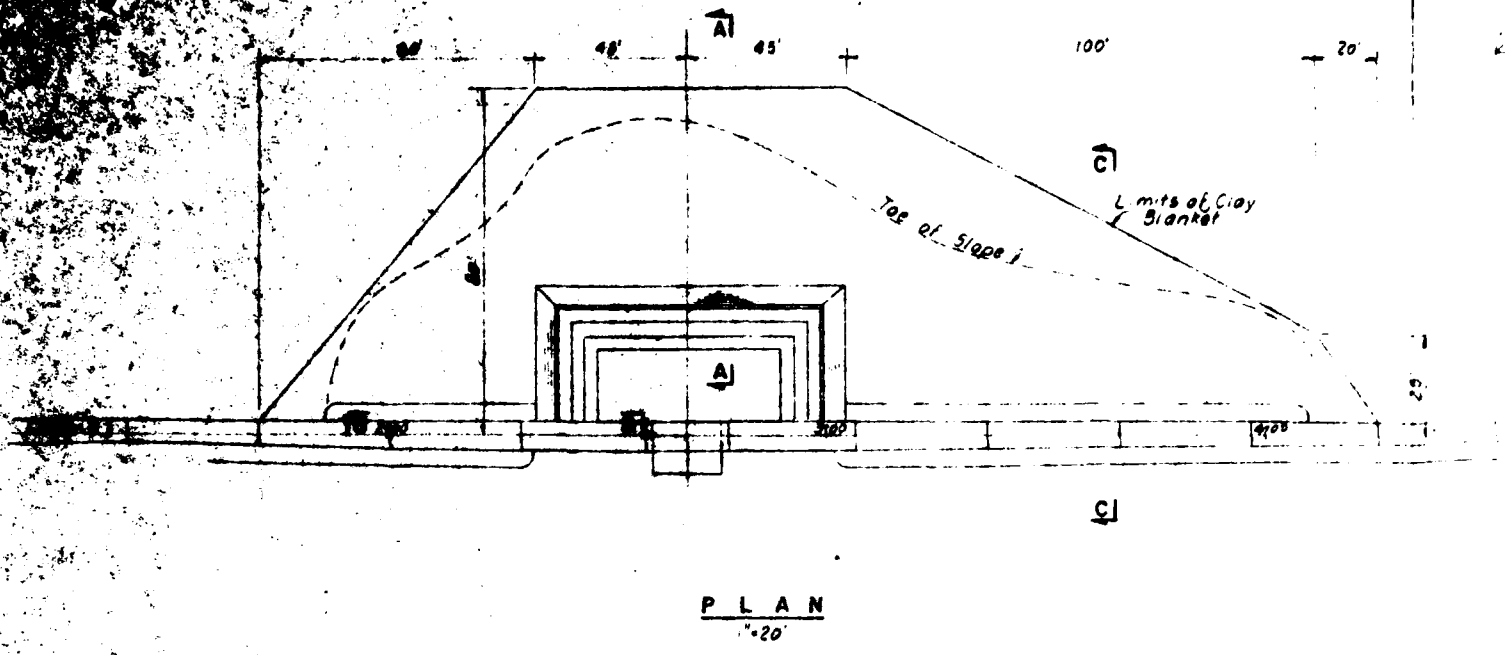
REHABILITATION OF EARL RESERVOIR

[illegible]

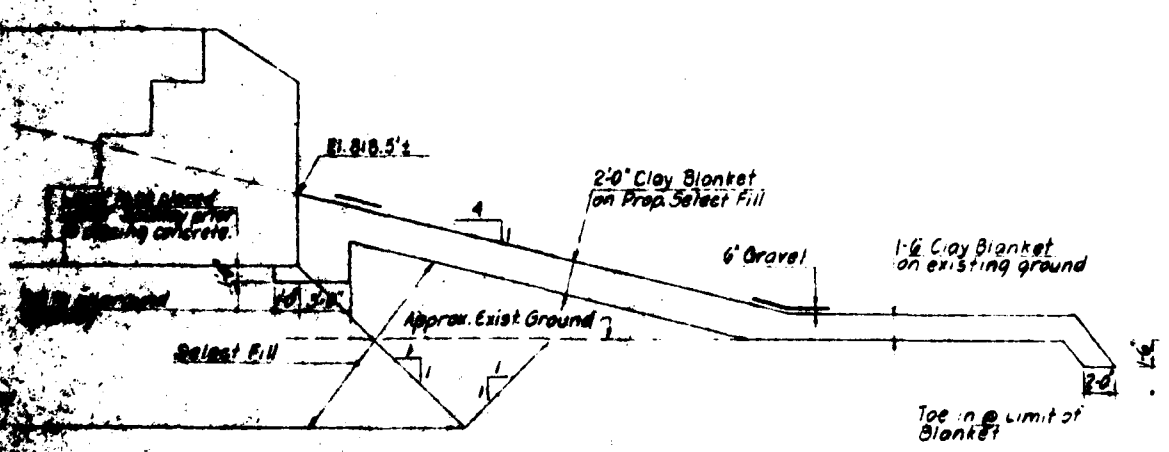
GENERAL PLAN & ELEVATION

RAMAPO ASSOC., P.C. CONSULTING ENGINEERS	[illegible]	[illegible]	[illegible]

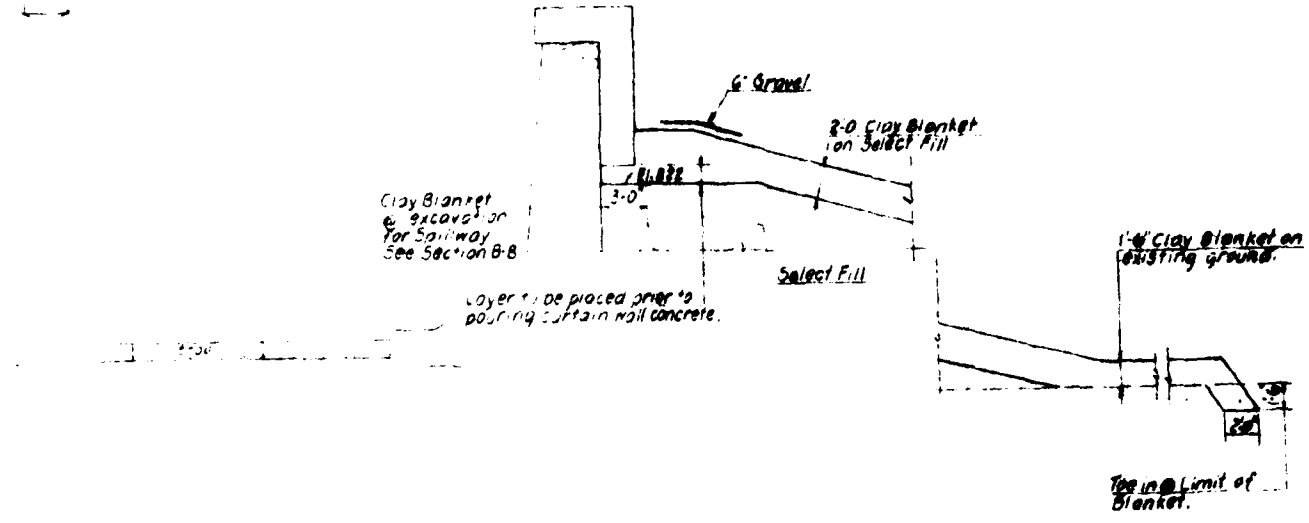
2



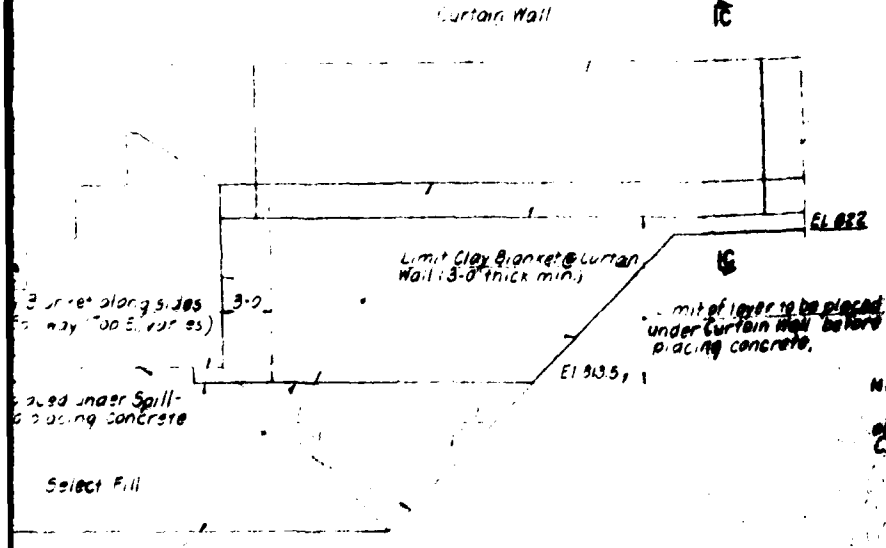
PLAN
1"=20'



SECTION A-A
1"=5'



SECTION C-C
1" = 5'



SECTION B-B
1" = 5'

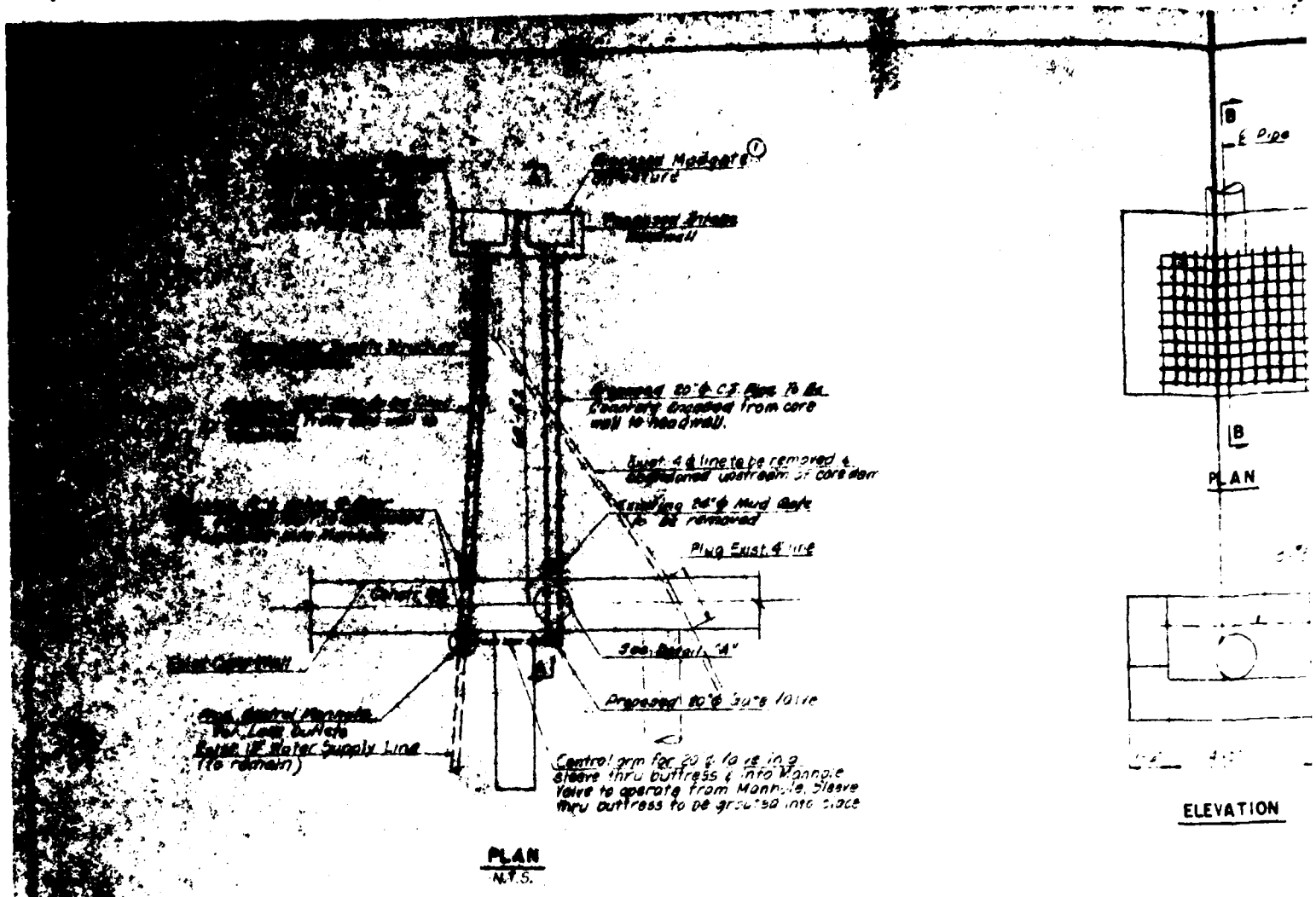
Note:
All exposed clay blanket shall be covered with a layer of gravel 6" thick. Top in @ Limit of Clay Blanket.

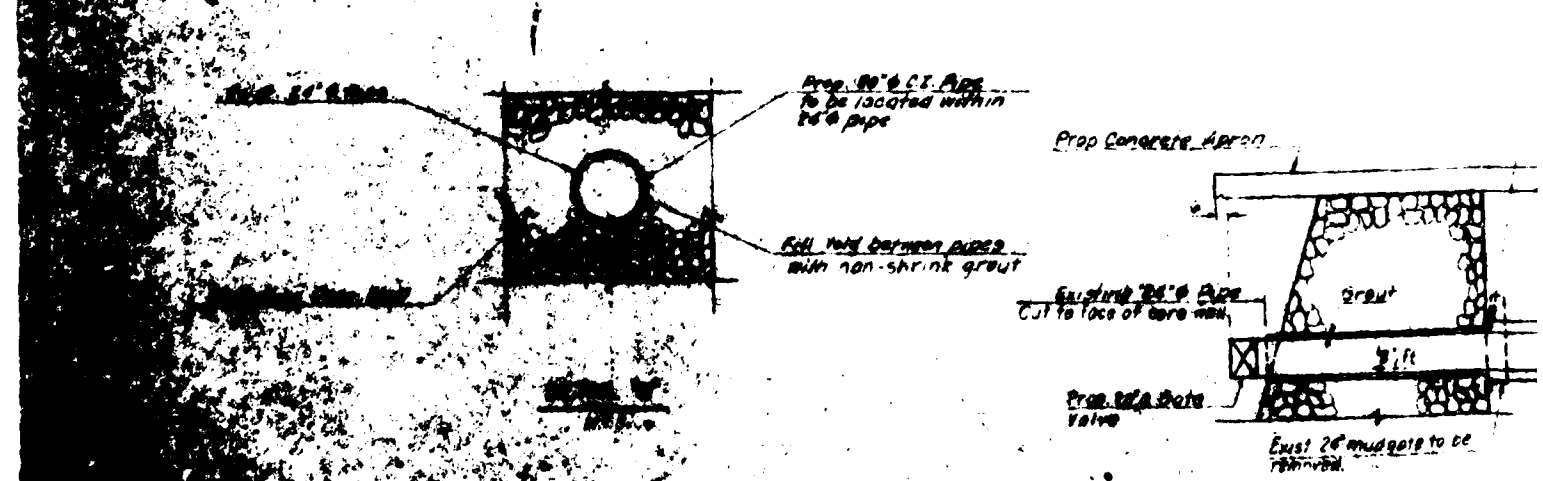
PLATE 7

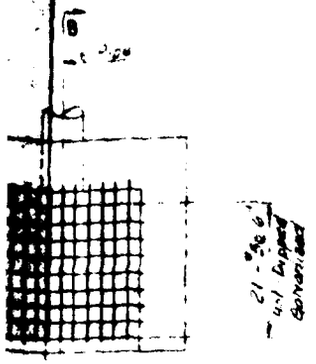
CLAY BLANKET

RAINHOUSE ASSOC., P.C. A.G. LICHTENSTEIN P.E. CONSULTING ENGINEERS	DR.		

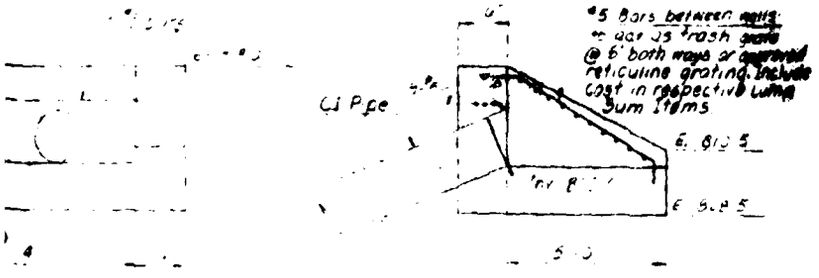
2


Proposed 20"ϕ C.I. Pipe to be Boundary Bracketed from core wall to headwall.
Exist. 4"ϕ line to be removed & capped at upstream of core wall
Existing 24"ϕ Mud Gate to be removed
Plug Exist. 4" line
Proposed 20"ϕ Gate Valve
Control arm for 20"ϕ to reach Sleeve thru buttress & into Manhole. Sleeve thru buttress to be grouted into place
PLAN
N.T.S.
B
PLAN
ELEVATION


Prop. 20"ϕ C.I. Pipe to be located within 24"ϕ pipe
Fill void between pipes with non-shrink grout
Prop Concrete Apron
Existing 24"ϕ Pipe Cut to face of core wall
Grout
2'-0"
Prop. 24"ϕ Gate Valve
Exist 24" mudgate to be removed



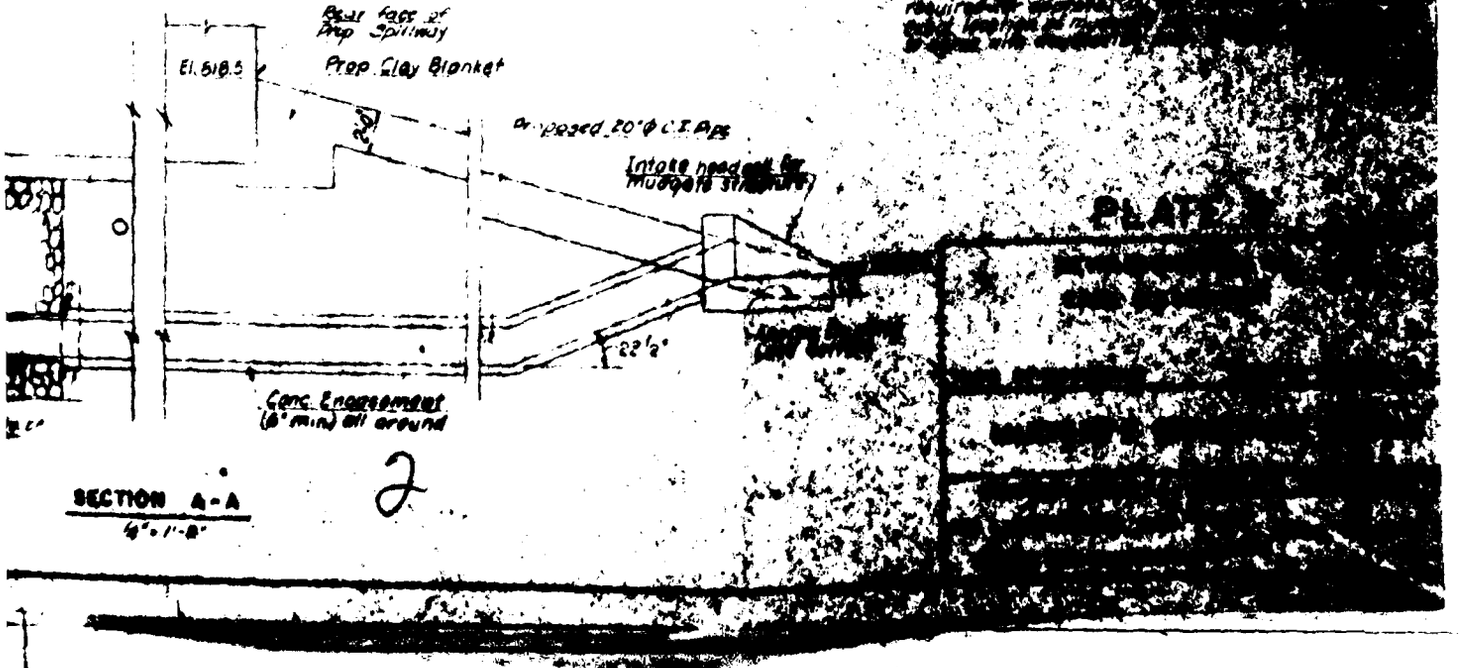
PLAN



ELEVATION

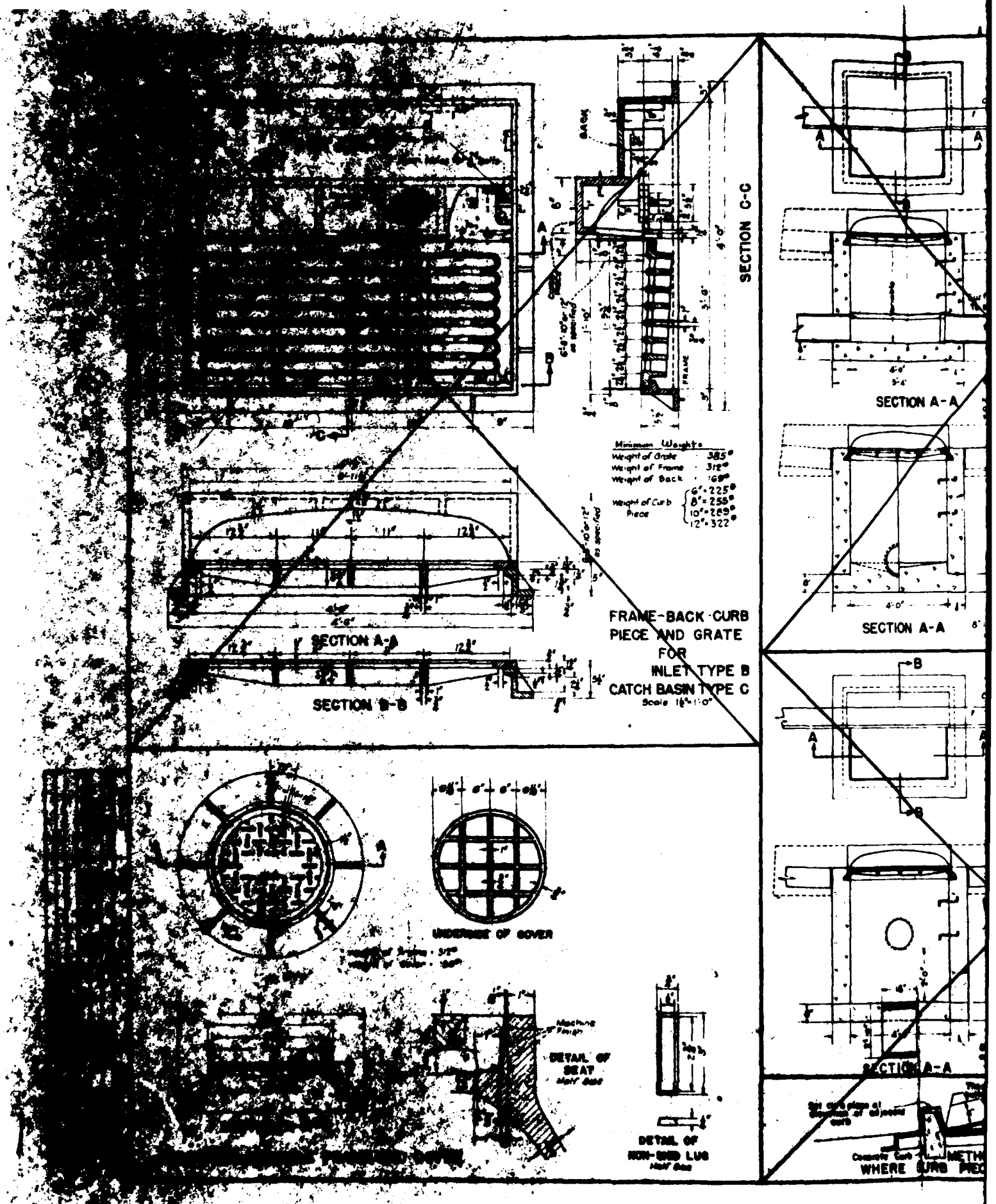
SECTION B-B

INTAKE HEADWALL DETAILS



SECTION A-A

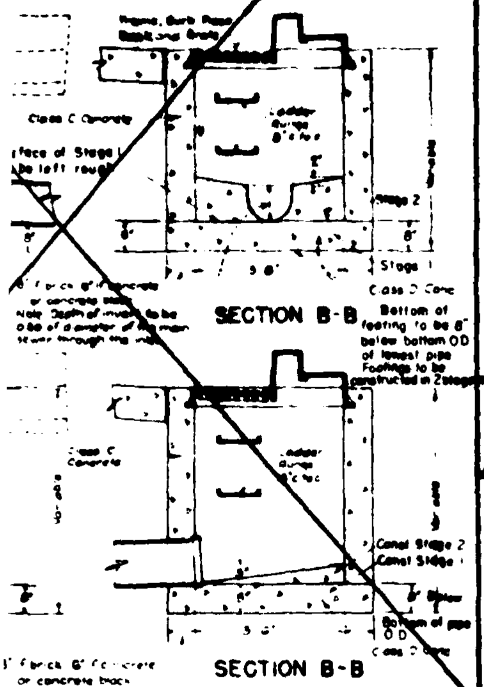
2


SECTION C-C
SECTION A-A
SECTION A-A
SECTION A-A
SECTION B-B
Minimum Weights
Weight of Grate 385#
Weight of Frame 312#
Weight of Back 169#
Weight of Curb Piece 6"=225# 8"=255# 10"=289# 12"=322#
FRAME-BACK-CURB PIECE AND GRATE FOR INLET TYPE B CATCH BASIN TYPE C
Scale 1½"=1'-0"
UNDERSIDE OF COVER
DETAIL OF SEAT
DETAIL OF
SECTION A-A

INLET TYPE B WITH C.I. CURB PIECE-BACK-FRAME AND GRATE

Scale ½"=1'-0"

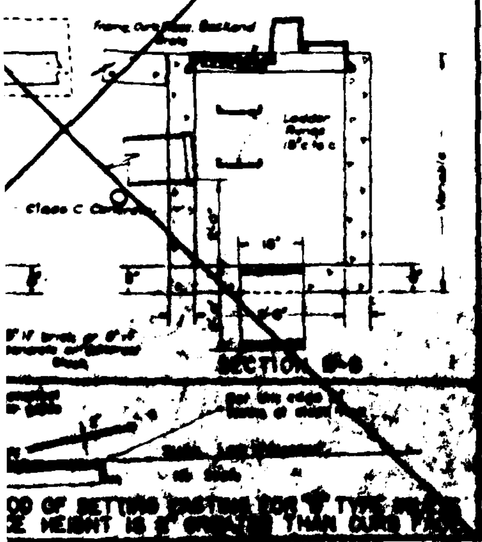
This inlet may be constructed of brick, concrete or concrete block. If brick or concrete block is used the bottom shall be as shown for concrete



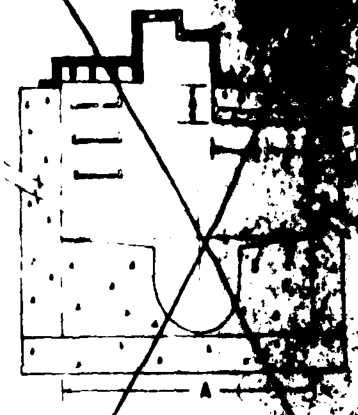
CATCH BASIN TYPE C WITH C.I. CURB PIECE-BACK-FRAME AND GRATE

Scale ½"=1'-0"

This basin may be constructed of brick, concrete or concrete block. If brick or concrete block is used the bottom shall be as shown for concrete. Alternate vertical joints of brick or block in five lower courses shall be left open. When constructed of concrete a leaching basin 18"x18"x2'-0" deep of 2½" trap rock or approved field stone shall be constructed.



INLETS TYPE B1 & TYPE [illegible]



INLET TYPE	DIMENSION A	[illegible]
B1	4'-8"	[illegible]
2	5'-8"	[illegible]

No Scale

GENERAL NOTES

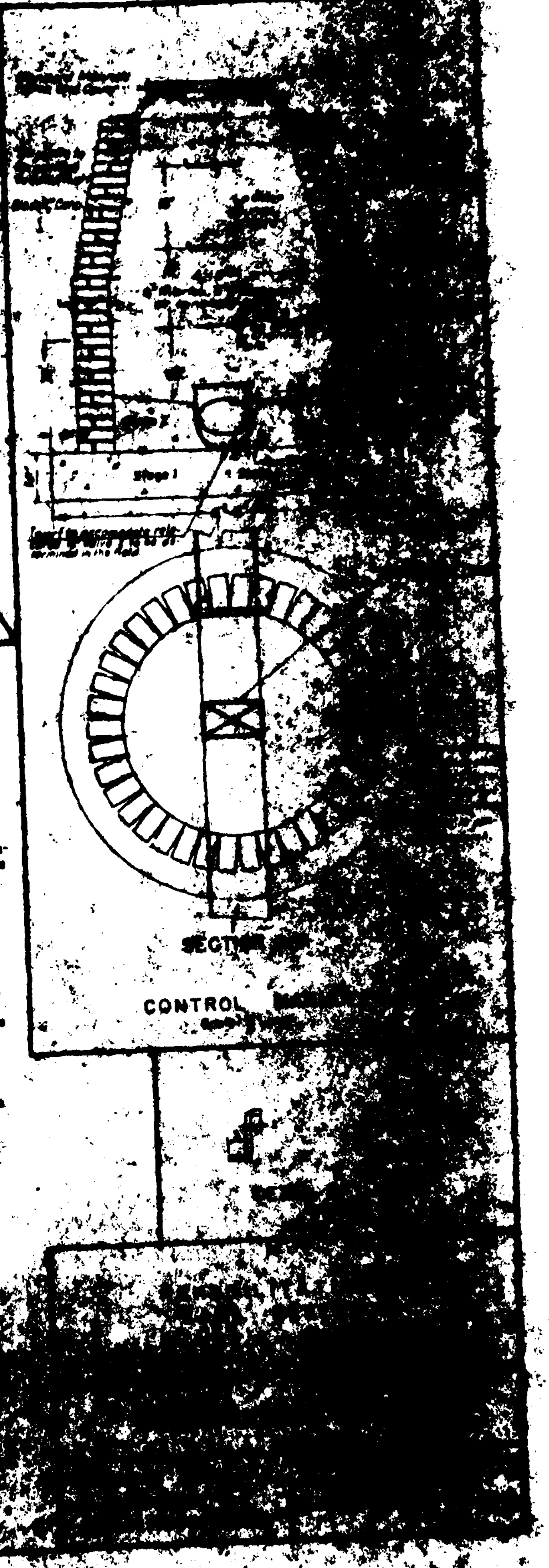
1. Corbelling of inlet walls [illegible] at the rate of 1/2" per 6" of [illegible] maximum corbel 6" per wall

2. When the item of [illegible] catch basins, additional depth [illegible] proposal and the depth of [illegible] as measured from top of [illegible] to invert of drainage structure, the [illegible] below a depth of 8' shall [illegible]. The overall horizontal [illegible] of foundations shall be increased 12" [illegible] to each 1'-0" depth increased to 12'.

3. Except for catch basins [illegible] footings and inverts shall [illegible] in two stages, and the bottom of [illegible] shall be 8" below the outer wall of the [illegible] in inlets and 10" in manholes

4. The item of reset heads [illegible] raising or lowering the head [illegible] of inlets and catch basins, or the resetting [illegible] castings, for a maximum of [illegible]. [illegible] other changes in position of head casting [illegible] as reconstructed manholes [illegible] inlets or catch basins

5. When curb piece height specified is greater than curb face height, depress the gutter of grate so that the top of curb piece is at the same elevation as the top of curb. (SEE DETAIL)



3

ENGINEER'S REPORT

REHABILITATION OF EARL RESERVOIR

TOWN OF WOODBURY
COUNTY OF ORANGE
STATE OF NEW YORK

RAIMONDI ASSOCIATES, P.C.
110 STAGE ROAD
MONROE, NEW YORK 10950

A. G. LICHTENSTEIN & ASSOCIATES
1298 TEANECK ROAD
TEANECK, N.J. 07666

MARCH 1978

GENERAL

The Earl Reservoir is a 16 ± acre pond located in the Town of Woodbury just north of Ridge Road about one mile west of the intersection of Ridge Road and New York State Route 32 (see Exhibit A). The pond is presently used as a recreational area for the residents of the Town. Up until 30 ± years ago the water in the pond was used for water supply purposes although the Town still maintains the right to use the water for said use in case of emergency need.

Water is contained in the pond by a masonry and earth dam constructed 65 years ago. The dam is approximately 425 feet in length with a maximum height above the old stream bed of some 26 feet. The existing spillway is divided into three (3) parts:

1. 15' long - 0.3' deep
2. 16' long - 1.0' deep
3. 15' long - 0.8' feet (total capacity 80± cfs)

The dam has a gated 24" emergency outlet (non-operative) as well as a 12" diameter intake for water supply purposes now used to drain most of the lake if needed.

Over the past few years several leaks in the outside face of the dam have been noted. During the summer of 1977 with little or no inflow for extended periods the lake level dropped more than 5 feet. Verification of location and magnitude of these leaks have been made by an underwater examination of the upstream face of the dam.

NOTE: A 2' diameter sinkhole near the spillway necessitated lowering of the lake beginning October, 1977. Lake level down 16' ±, lake surface reduced by 90% ±.

DESCRIPTION OF WATERSHED

The pond is located in a bowl shaped basin with the northern limit being the ridge of the Schunnemunk Mountains. Upstream ground slopes are quite severe, in some areas being well in excess of 30%. The predominant land use in the upstream watershed is forest with a small percent of swamp and an even smaller percent (1±) of suburban lands. Due to the shape of the basin there are several main tributaries to the pond. In developing the hydrology the drainage basin was divided into six (6) significant areas to better establish the Q100 at the spillway.

Below the dam the stream flows through a fairly steep reach for a distance of some 3000 ± feet. Below this point the channel flattens and broadens considerably into a wide flood plain. There are two road crossings in the first reach namely Ridge Road about 1000 ± feet downstream of the dam and Jones Road about 1700 ± feet downstream. At Ridge Road the roadway is about 15 feet above the stream bed. Any flood surge should be substantially attenuated at this point. The upstream easterly bank at Ridge Road is approximately 12 feet higher than the stream. During a surge water could flow down Ridge Avenue in an easterly direction. However, this possible overflow

should not have a significant downstream effect. Between Ridge Road and Jones Road there are five dwellings in the vicinity of the channel. However, these homes are 12-15 feet higher than the stream. At Jones Road the road bed is more than 10 feet above the stream. There is one dwelling below Jones Road, however, any possible overflow should not present a serious hazard to same. Below Jones Road, there are no dwellings until the channel broadens considerably. The remaining downstream basin has scattered dwellings. Based upon our inspection of the area, it is our opinion that a hazard rating of "b" as defined by the SCS should be adequate for the design of the spillway. A review of the attached calculations should reveal that design of the proposed spillway is quite conservative with a substantial factor of safety built-in.

HYDROLOGY

The Q_{100} for the project was developed using the Soil Conservation Service "Soil Complex Method" as explained in Technical Release # 55. As indicated the shape of the basin necessitated dividing it up into six areas. This procedure produced a fairly high Q_{100} of 1258 cfs for a total tributary area of 464 acres. The general data input included a 100 year, 24 hour rainfall of 7.20", a Type II rainfall distribution, a hydrologic soil Group of C based upon 5 different soil types within the basin and a general land use conforming to woods (see calculations).

A copy of our calculations were submitted to the SCS office in Middletown. Attached and labelled Exhibit S is an endorsement by the SCS of our evaluations.

HYDRAULICS

To preserve the beauty of the existing structure it is intended to rebuild a portion of the dam upstream of the existing face. The drawings indicate the new dam to be rectangular in shape having a single spillway 110 feet in length. The spillway overflow will cascade down over a series of steps provided as an energy dissipator as well as for its aesthetics. Below the spillway an opening will be made in the existing dam to allow the flow to continue downstream. The existing bridge shown on the plans will be removed with access to the recreation site being provided from a different source.

Using 150% of Q_{100} for design of the spillway and a spillway length of 110 feet a routed discharge of 1392cfs has been computed. The maximum elevation of the upstream pool is 830.65 or some 2.45 feet above the spillway crest. Total storage above the spillway crest is approximately 44.82 acre feet. The existing top of the dam (elevation 829.8) to be raised to elevation 832.00 to provide necessary freeboard.

To check if the single spillway can evacuate 75% of the storage between maximum high water and the spillway crest within 48 hours we may calculate as follows. Using the falling head equation (no inflow assumed)

$dt = A^{*}dy/Cly^{3/2}$ * - A assumed constant

Integrate between y=H (2.45 ft) and Y=0 (Spillway Crest)

$t = 2A/CHL^{1/2}$

A= Average Lake Area = $\frac{\text{Total Storage at Q Peak}}{\text{Depth of Flood Above Crest}} = \frac{44.82}{2.45} = 18.29$ Acres

18.29 Acres = 796,712 Square Feet

C = Weir Coefficient = 3.3

L = Length of Spillway = 110 feet

t = time to empty = $\frac{2(796,712)}{3.3(110)\ (2.45)^{1/2}} = 2805$ Seconds = 47 $\pm$ Minutes

No Problems to evaluate all flow above spillway Crest within 48 hours.

Similarly the criteria of being able to evacuate 90% of the storage below the lowest spillway crest within 14 days may be checked as follows:

First it must be noted that when it was decided to lower the water in the lake for safety, the existing 12" intake was utilized for this purpose. With normal inflow, it took approximately 4 to 5 days to lower the lake some 16 feet. It has already been noted that at this elevation more than 90% of the lake area is gone.

The present proposal is to reactivate the mud gate. The plans indicate that a 20 inch outlet is proposed for this purpose. It is obvious from the discussion above that the new mud gate facility would be more than adequate to meet the criteris of discharging 90% of the lake volume below the spillway crest within a 14 day period. However, to tie it down more exactly, we may calculate the following:

$dt = Ady/Ca\ \sqrt{2gy}$

Integrate between y=H (H_t of Spillway Crest Above ℄ of 20" outlet and $y=H_2$ (Selected at 1' above ℄ of 20" outlet)

$t = \frac{2A}{Ca}\ \frac{(\sqrt{H_1} - \sqrt{H_2})}{\sqrt{2g}}$

A = Average Lake Area between Spillway Crest (16$\pm$) and Lake @ El.810 (2 Ac) or 9 Ac (392,040 Sq. Ft.)

C = Orifice Constant = Say 0.6

a = Area of 20" Ø outlet pipe = 2.18 Sq. Ft.

$H_1 = 17 \quad H_2 = 1$

$t = \frac{2\ (392,040)\ \ (\sqrt{17} - \sqrt{1})}{0.6\ \ (2.18)\ \ (8.01)} = 2.71$ Days NO PROBLEM

Upon cascading down the spillway the flood will pass through an opening to be cut into the old dam. Said opening will be 15 feet wide conforming to the width between butresses below the present spillway. Considering the opening as a culvert with inlet control, the total depth of flow using procedures in BPR (HEC # 5) would be 11.0 feet. With an invert proposed of 815.0 this depth converts to 826.0. The opening proposed still allows for lake control at the spillway.

Upon passing through the opening in the old dam the water drops about 10-1/2 feet into a plunge pool which is aided by a three foot high check dam located immediately below the drop. This installationwill aid in the dis-apation of engerty created by the flood. The entire channel below the dam will be rip-rapped a distance of some 125 feet.

STRUCTURAL CONSIDERATIONS

Earl Reservoir was constructed circa 1912 as an earth dam with a masonry core wall. In recent years, there have developed various forms of leaks through the dam masonry with the water level dropping several feet below the spillway, particularly in the summer season. Also, the stone masonry has been damaged by wave and ice action on its upper portions. These concerns combined with aesthetic considerations and a need to improve the hydraulic capacity of the spillway led to the development of the proposed structure.

Soil Borings were taken for the proposed project. The underlying soils for the structure were found to be dense and sandy soils containing varying proportions of silty clay. These materials were deemed to be of a suitable bearing and permeability capacity to meet the needs of the project. A copy of the Boring Logs are included elsewhere in this Report.

An underwater inspection of the existing structure made by certified divers and several sink holes were discovered along and near the upstream face of the core wall. One sink hole in particular was approximately two (2') feet in diameter and appeared to be causing a migration of fine materials, through the dam, to an outflow area discovered 75'+ downstream. Concern for the progressive nature of this type of failure led to the lowering of the reservoir.

In light of the accumulated data, the proposed structure was selected to incorporate a steel sheeting cut-off wall capped by a reinforced concrete curtain wall along the existing core wall. This is tied into a reinforced concrete spillway with a designed crest length of 110'.

Various other architectual and aesthetic treatments were included in the proposed projects to compliment the recreational nature of the site.

Re: Our File # 77-1170
Earl Reservoir

ESTIMATE OF QUANTITIES

Item Number	Item	Unit	Quan.	Unit Price	Total
1.	Clearing & Grubbing	L.S.	L.S.	$5,000.	$ 5,000.00
2.	Removal of Bridge & Core-wall Section	L.S.	S.S.	10,000.	$ 10,000.00
3.	Unclassified Excavation and Disposal	C.Y.	1900	$ 3	$ 5,700.00
4.	Select Fill	C.Y.	1250	$ 6	$ 7,500.00
5.	Class B Concrete For Structures	C.Y.	900	$ 160.	$144,000.00
6.	Bar Eninforcement for Structures	LBS.	24,500	$ .65	$ 15,925.00
7.	Corrugated Steel Pipe 24 inch diameter	L.F.	375	$ 20.	$ 7,500.00
8.	Mudgate Structure	L.S.	L.S.	$ 5,000.	$ 5,000.00
9.	Water Supply Structure Modification	L.S.	L.S.	$ 3,000.	$ 3,000.00
10.	Inlets, Type A	Unit	3	$ 1,000.	$ 3,000.00
11.	Manholes	Unit	1	$ 1,500.	$ 1,500.00
12.	Beam Guide Rail (Timber Faced)	L.F.	125	$ 10.	$ 1,250.00
13.	Pipe Railing	L.F.	510	$ 20.	$ 10,200.00
14.	Topsoil (4" TH.) and Seeding	S.Y.	1100	$ 3.	$ 3,300.00
15.	Dry, Rip-Rap	C.Y.	170	$ 30.	$ 5,100.00
16.	Permanent Steel Sheet Piling	S.F.	8700	$ 12.	$104,400.00
		Total			$332,375.00

Hydrologic Evaluation

Earl Reservoir - Town of Woodbury

Total Drainage Area - 464 acres (0.725 Sq. Mi.) Exhibit A
Storm Precipitation - 7.20" (100 year rainfall) Exhibit B
Use SCS Type II Rainfall Distribution

A) Divide basin into 6 drainage areas.
B) Use procedures SCS TR#55.

Drainage Area #1

a) D.A.=110 acres (0.172 SQ. Mi.)

b) T_t~1) Overland Flow 40' in 600' (fig. 3-1) also Exhibit C

2) Channel Flow 650' in 3700 (see exhibit attached) Exhibit D

T_t(1) = 600/0.66(60) = 15 minutes
T_t(2) = 9 minutes
T_c~24 minutes, Use 0.4 hour

c) Hydrologic Soil Group - Use C (soil types, bath, swartz-wood & Lacka wanna, Scribia-Sun, Arnot-Oqaqua Rocky and Arnot Rock Outcrop)

d) Land Use - Good Woods - Exhibit E

e) Curve Number - 70 - Exhibit E

*f) Run-off (precipitation) - 3.79" = d, Note: From SCS TP 149.

g) Travel Time to Lake - T_t 14' in 700' = 5+minutes (say 0.10 hour)

*May obtain directly from SCS National Engineering Handbook.

Drainage Area #2

a) D.A. = 107 acres (0.167 Sq. Mi.)

b) T_t~1) O.F. 20' in 400' T_t = 13 minutes

2) C.F. 670' in 4500' T_t = 12 minutes

T_c~25 minutes Use 0.4 hour

c) Hydrologic Soil Group - C

d) Land Use - Good Woods

e) Curve Number - 70

f) R.O. = 3.79"

g) Tt to Lake - 0.10 hour

Drainage Area #3

a) D.A. = 144 acres (0.225 Sq. Mi.)

b) T_t ~ 1) O.F. 80' in 800' T_t = 19 minutes

2) C.F. 400' in 1200' - (swamp) - 180' in 2200'
T_t = 11 minutes T_c = 30 minute or 0.50 hour
Note: A swampy area cosisting of 10+ acres exists mid-way up basin. Based upon methods in TR-55 peak flow could be reduced by some 25%. The new peak (using table 5-3) coincides with a T_c in excess of 0.8 hour (see Exhibit F). Use T_c~0.75 hour.

c) Hydrologic Soil Group - C

d) Land Use - Good Woods

e) Curve Number - 70

f) Run-off - 3.79"

Drainage Area #4

a) D.A. = 20 acres (0.031 Sq. Mi.)

b) $T_t = T_c$ = O.F. = 100' in 1000'~21 minutes, use 0.3 hour

c) Hydrologic Soil Group - 5 acres D and 15 acres C

d) Land Use - Good Woods

e) Curve Number - 5(77) + 15(70)/20 = 71.8

f) Run-off - 3.97"

Drainage Area #5

a) D.A. = 25 acres (0.039 Sq. Mi.)

b) $T_t = T_c$ = O.F. = 140' in 1100"~20 minutes, use 0.3 hour

c) Hydrologic Soil Group - C

d) Land Use - Good Woods

e) Curve Number - 70

f) Run-off~3.79"

Drainage Area #6

a) D.A. = 58 acres (0.091 Sq.Mi.)

b) $T_t = T_c$ = O.F. = 110' in 1250'~28 minutes, use 0.5 hour

c) Hydrologic Soil Group - 43 acres C and 15 acres pond

d) Land Use - Good Woods

e) Curve Number - 43(70) + 15(100)/58 = 77.8

f) Run-off~4.64"

See Exhibit G-3

FLOOD ROUTING (STEP METHOD)

A) Stage vs. Discharge

1) Select spillway length to keep lake depth to within 3.0 of normal during flood flow.

2) Provide additional freeboard - Require at least 1.0' above flood level.

3) Use trapezoidal weir section - inclined upstream face vertical downstream face - Exhibit H

4) Select weir length 110 feet - use C=3.3 (conservative)

Stage (ft)	Discharge (cfs)	Stage (ft)	Discharge(cfs)
0	-	2.3	1342
0.3	63	2.8	1804
0.8	275	3.3	2176
1.3	570	3.8	2689
1.8	930		

Datum Elevation 828.2

B) Stage vs. Storage

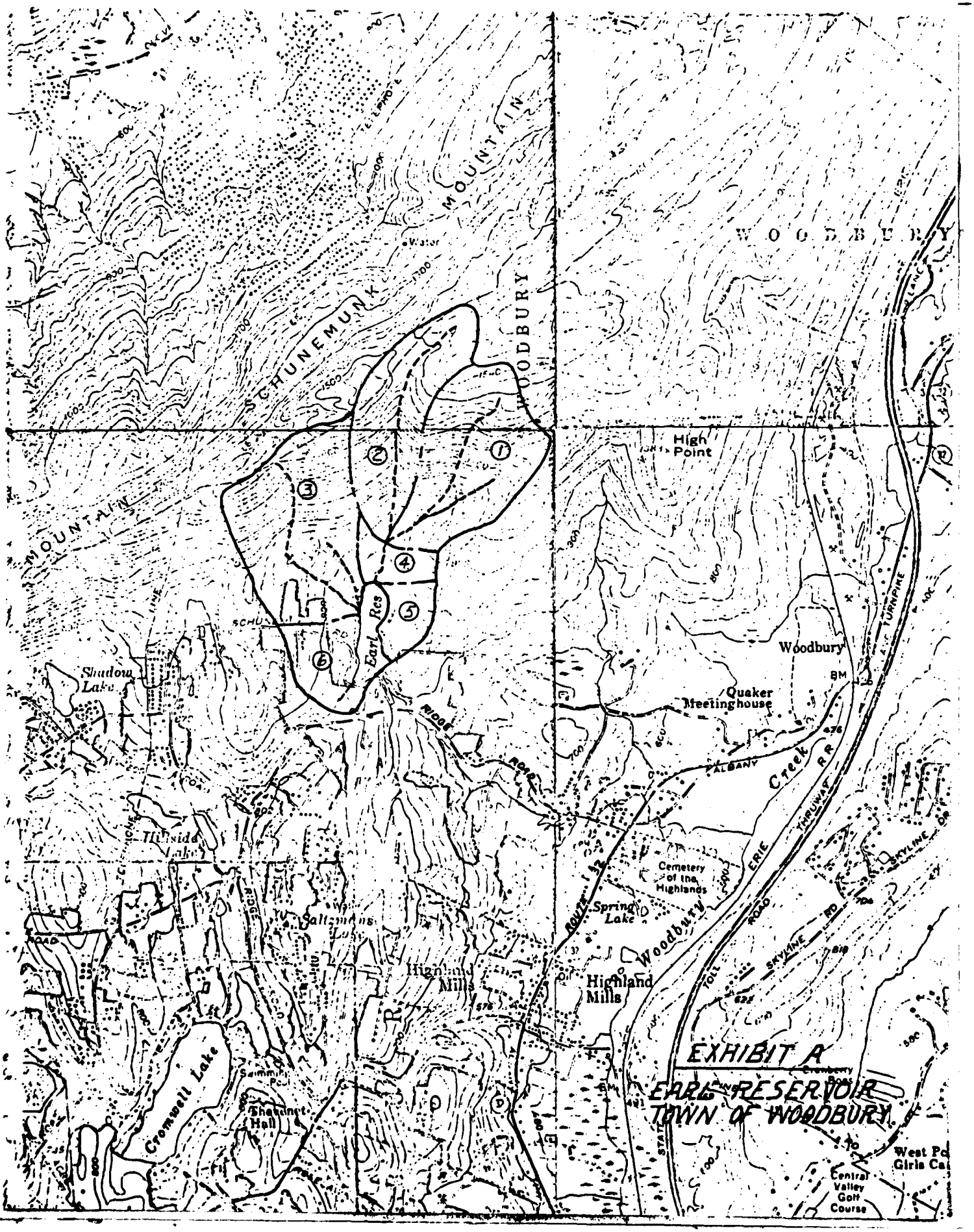
Stage (ft)	Elevation	Lake Area (ac)	Storage (Ac-ft)
0	828.2	16.00	
0.3	828.5	16.82	4.92
0.8	829.0	17.65	13.54
1.3	829.5	18.47	22.57
1.8	830.0	19.30	32.01
2.3	830.5	19.85	41.80
2.8	831.0	20.40	51.86
3.3	831.5	20.95	62.20
3.8	832.0	21.50	72.81

FLOOD ROUTING CHART A *Δt= 0.10 hour - 360 seconds

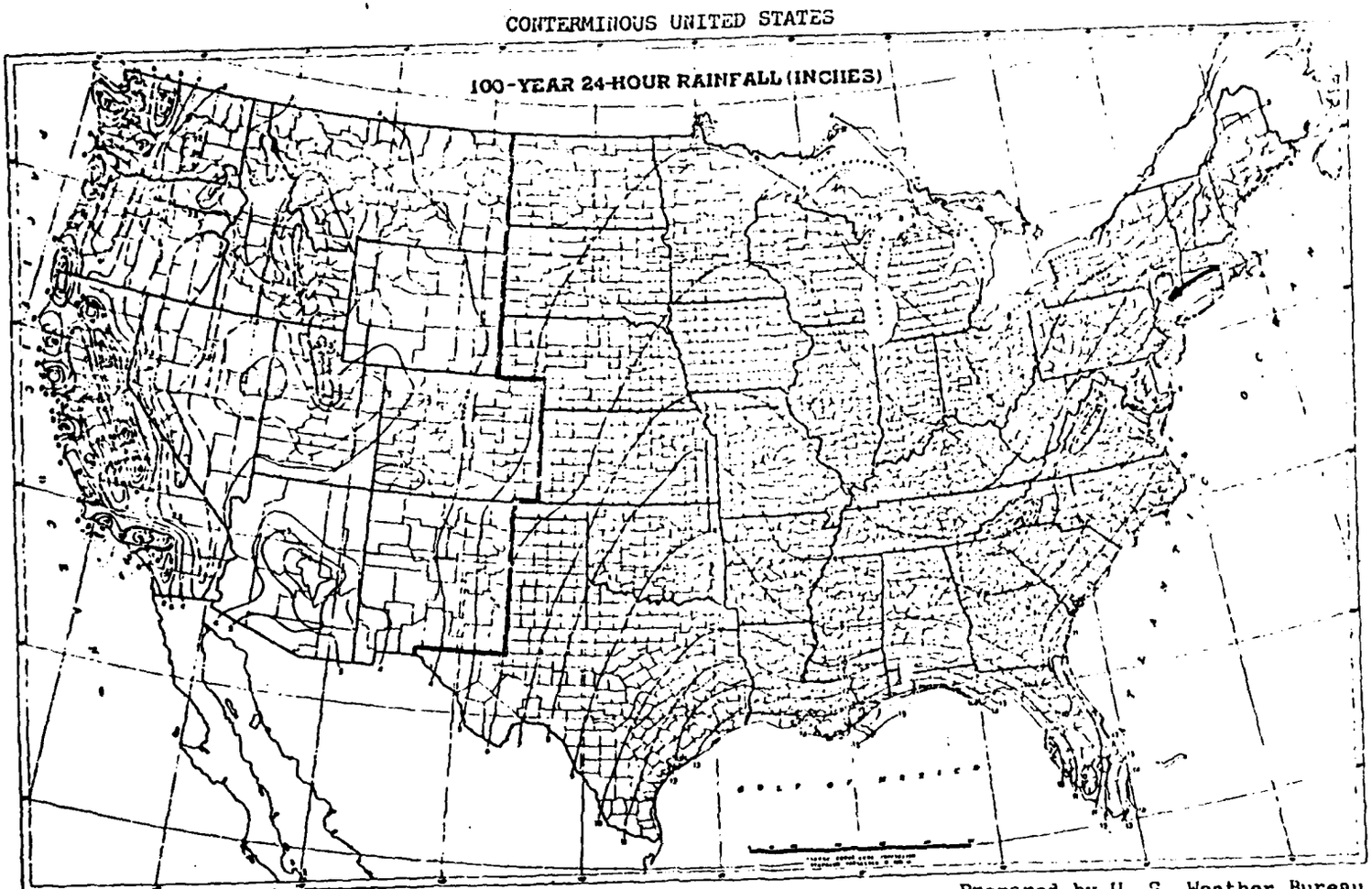
Stage (ft)	A(Acres)	Q(cfs-out)	Q/2	Storage (Ac-ft)	S/Δt*	S/Δt-Q2	S/Δt+Q/
0	16.00	-	-	0	0	--	-
0.3	16.82	63	32	4.92	595	563	627
0.8	17.65	275	138	13.54	1638	1500	1776
1.3	18.47	570	285	22.57	2731	2446	3016
1.8	19.30	930	465	32.01	3873	3408	4338
2.3	19.85	1342	671	41.80	5058	4387	5729
2.8	20.40	1804	902	51.86	6275	5373	7177

FLOOD ROUTING CHART B - See Exhibit J

Hour	Inflow(cfs)	Iav	150% Iav	S/Δt-Q/2	S/Δt+Q/2	H(ft)	Qout-cfs
11.0	47	-	-	-	-	.15	20(est
11.1	55	51	77	285	362	.17	25
11.2	64	60	90	325	415	.20	32
11.3	74	69	104	385	489	.24	43
11.4	84	79	119	465	584	.29	56
11.5	95	90	135	550	685	.33	69
11.6	145	120	180	630	810	.39	88
11.7	217	181	272	740	1012	.48	121
11.8	442	330	495	905	1400	.65	190
11.9	799	621	932	1225	2157	.98	352
12.0	1107	953	1430	1850	3280	1.41	608
12.1	1258	1183	1774	2670	4444	1.85	913
12.2	1211	1235	1853	3540	5393	2.19	1176
12.3	1084	1148	1722	4200	5922	2.38	1333
12.4	922	1003	1509	4600	6109	2.45	1392
12.5	759	841	1262	4725	5987	2.41	1358


SCHUNEMUNK MOUNTAIN
WOODBURY MOUNTAIN
WOODBURY
High Point
Earl Res
Shadow Lake
Hillside Lake
Cromwell Lake
Saltmans
Highland Mills
Woodbury
Quaker Meetinghouse
Spring Lake
Cemetery of the Highlands
Central Valley Golf Course
EXHIBIT A
EARL RESERVOIR
TOWN OF WOODBURY

CONTERMINOUS UNITED STATES



Prepared by U. S. Weather Bureau

C-5

EARL RESERVOIR
TOWN OF WOODBURY

EXHIBIT B

...then ... by dividing the total overland flow length by the average ...

EXHIBIT C

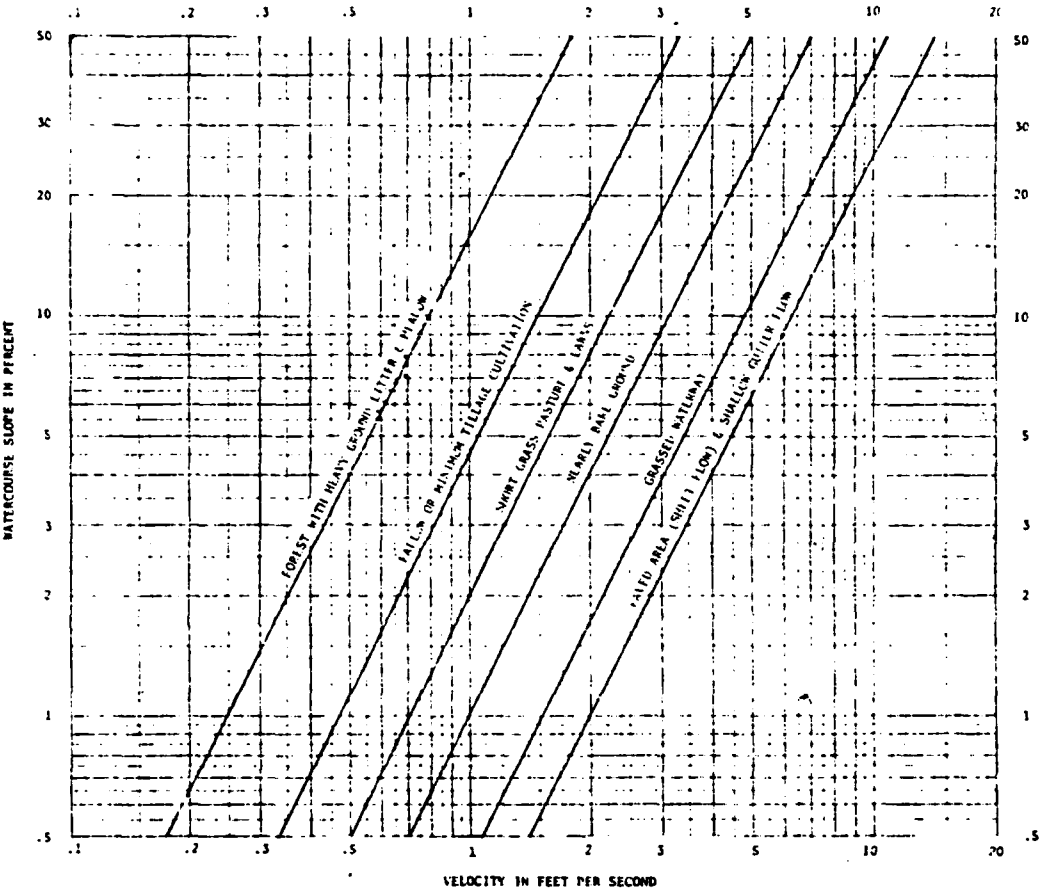


Figure 3-1.--Average velocities for estimating travel time for overland flow.

Storm sewer or road gutter flow

Travel time through the storm sewer or road gutter system to the main open channel is the sum of travel times in each individual component of the system between the uppermost inlet and the outlet. In most cases average velocities can be used without a significant loss of accuracy. During major storm events, the sewer system may be fully taxed and additional overland flow may occur, generally at a significantly lower velocity than the flow in the storm sewers. By using average conduit sizes and an average slope (excluding any vertical drops in the system), the average velocity can be estimated using Manning's formula.

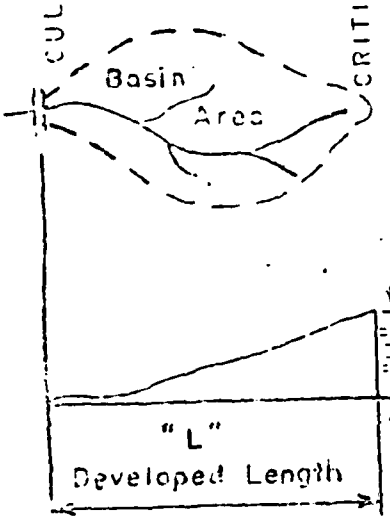
Since the hydraulic radius of a pipe flowing half full is the same as when flowing full, the respective velocities are equal. Travel time may

EARL RESERVIOR
TOWN OF WOODBURY

Nomograph For The Calculation Of "T"

EXHIBIT D

For use with Rational Formula to find "Q"



H — Elevation in Feet of Critical Point on Watershed above Point of Concentration

L — Length of Channel from Critical Point To Point of Concentration

T — Time of Flood Concentration

MILES | FEET

Example

Given H = 900'

L = 3 Miles

By Calc. T = 40 Min.

$Q = CIA$

EARL RESERVOIR
TOWN OF WOODBURY

EXHIBIT E

Table 2-2.- Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2]	25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3]				
Average lot size — Average % Impervious[4]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

1/ For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

2/ Good cover is protected from grazing and litter and brush cover soil.

3/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

4/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

5/ In some warmer climates of the country a curve number of 95 may be used.

EARL RESERVOIR
TOWN OF WOODBURY

EXHIBIT F

Table E-3. --Adjustment factors where ponding and swampy areas are spread throughout the watershed or occur in central parts of the watershed

Ratio of drainage area to ponding and swampy area	Percentage of ponding and swampy area	Storm frequency (years)					
		2	5	10	25	50	100
500	0.2	0.94	0.95	0.96	0.97	0.98	0.99
200	.5	.88	.89	.90	.91	.92	.94
100	1.0	.83	.84	.86	.87	.88	.90
50	2.0	.78	.79	.81	.83	.85	.87
40	2.5	.73	.74	.76	.78	.81	.84
30	3.3	.69	.70	.71	.74	.77	.81
20	5.0	.65	.66	.68	.72	.75	.78
15	6.7	.62	.63	.65	.69	.72	.75
10	10.0	.58	.59	.61	.65	.68	.71
5	20.0	.53	.54	.56	.60	.63	.68
4	25.0	.50	.51	.53	.57	.61	.66

Table E-4.--Adjustment factors where ponding and swampy areas are located only in upper reaches of the watershed

Ratio of drainage area to ponding and swampy area	Percentage of ponding and swampy area	Storm frequency (years)					
		2	5	10	25	50	100
500	0.2	0.96	0.97	0.98	0.98	0.99	0.99
200	.5	.93	.94	.94	.95	.96	.97
100	1.0	.90	.91	.92	.93	.94	.95
50	2.0	.87	.88	.88	.90	.91	.93
40	2.5	.85	.85	.86	.88	.89	.91
30	3.3	.82	.83	.84	.86	.88	.89
20	5.0	.80	.81	.82	.84	.86	.88
15	6.7	.78	.79	.80	.82	.84	.86
10	10.0	.77	.77	.78	.80	.82	.84
5	20.0	.74	.75	.76	.78	.80	.82

These conditions may occur in a proposed or existing urban or suburban area and the adjustment factors from tables E-2, E-3, or E-4 should be applied after the peaks have been adjusted for the effects of urbanization as described in chapter 4.

Example E-3

A 5-acre pond is located at the downstream end of a 100-acre watershed in which a housing development is proposed. The average watershed slope is 4 percent and the present-condition curve number is 75. After the installation of the housing development, 30 percent of the watershed will be impervious and 50 percent of the hydraulic length will be modified. The future-condition curve number is estimated to be 80. For a rainfall

EARL RESERVOIR
TOWN OF WOODBURY

EXHIBIT G-1

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)--Continued Sheet 2 of 5

TIME OF CONCENTRATION = 0.3 hours
Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	21	43	141	324	586	658	535	372	251	184	148	124	102	86	77	71	61	51	41	34	30	24	18	14
0.25	17	31	43	67	134	279	461	559	530	428	318	234	179	143	116	97	76	59	45	37	32	25	18	15
0.50	13	22	29	34	42	65	124	238	78	479	499	447	363	281	216	168	110	74	51	41	34	26	19	15
0.75	10	17	21	24	27	32	41	63	114	203	316	413	457	443	389	319	198	105	60	45	37	28	20	15
1.00	8	13	16	18	20	23	26	31	40	60	103	176	269	358	415	426	344	182	77	51	41	30	20	16
1.50	5	8	10	11	12	13	15	16	18	21	24	28	36	52	82	132	272	382	192	81	52	34	22	17
2.00	3	5	6	7	8	8	9	10	11	12	14	15	17	19	21	25	44	151	351	198	85	41	24	18
2.50	1	3	4	4	5	5	6	6	7	8	8	9	10	11	12	14	17	28	162	328	200	54	27	19
3.00	0	1	2	2	3	3	3	4	4	5	5	6	6	7	8	9	10	14	33	169	309	94	30	20
3.50	0	0	1	1	1	1	2	2	2	3	3	3	4	4	5	5	6	9	14	38	172	294	35	22
4.00	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	4	5	9	15	43	281	42	24

TIME OF CONCENTRATION = 0.4 hours
Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	20	39	103	224	419	558	575	451	331	247	190	155	127	105	90	80	66	53	42	35	30	24	18	14
0.25	15	28	38	54	98	196	343	467	508	464	380	295	228	180	145	119	87	64	47	38	32	26	19	15
0.50	12	20	26	30	37	53	92	172	286	395	462	453	402	332	266	211	137	84	54	42	35	27	19	15
0.75	10	16	19	22	25	29	36	51	85	150	242	338	407	429	406	356	241	128	65	47	38	29	20	16
1.00	8	12	15	17	19	21	24	28	34	49	78	132	208	292	362	403	368	220	88	55	42	30	21	16
1.50	5	8	9	10	11	12	14	15	17	19	22	25	31	43	65	102	220	365	224	93	56	35	22	17
2.00	3	5	6	6	7	8	9	9	10	11	13	14	16	17	20	23	37	119	338	225	99	43	24	18
2.50	1	3	3	4	4	5	5	6	6	7	8	9	10	11	12	13	16	25	132	317	225	58	27	19
3.00	0	1	2	2	2	3	3	3	4	4	5	5	6	7	8	10	13	28	140	300	107	31	21	
3.50	0	0	1	1	1	1	1	2	2	2	3	3	3	4	4	5	6	8	13	32	146	286	36	22
4.00	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	5	8	14	36	275	44	24

EARL RESERVOIR
TOWN OF WOODBURY

5-8

EXHIBIT G-e

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)--Continued Sheet 3 of 5

TIME OF CONCENTRATION = 0.5 hours
Hydrograph time in hours

T_a	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	18	26	00	266	331	433	496	474	395	309	242	194	158	130	109	94	75	57	43	36	31	25	18	15
0.25	15	25	37	52	94	172	277	372	425	424	353	326	270	221	182	150	107	73	49	39	33	26	19	15
0.50	12	20	25	30	38	58	101	169	252	327	374	385	366	329	285	241	169	103	59	44	36	27	19	15
0.75	9	15	19	22	25	30	41	63	103	162	229	282	335	354	348	325	255	157	77	50	39	29	20	16
1.00	7	12	15	17	19	21	25	31	43	66	103	153	210	264	304	327	317	231	109	61	44	31	21	16
1.50	5	8	9	10	11	12	14	15	17	20	24	31	43	63	92	129	214	295	224	115	65	36	23	17
2.00	3	5	6	6	7	8	9	10	11	12	13	14	16	19	23	30	58	143	271	216	120	46	25	18
2.50	1	3	3	4	4	5	5	6	7	7	8	9	10	11	12	14	18	39	150	253	209	71	28	19
3.00	0	1	2	2	2	3	3	4	4	4	5	5	6	7	7	8	10	15	48	154	239	126	32	21
3.50	0	0	1	1	1	1	2	2	2	2	3	3	4	4	5	5	6	8	16	56	155	227	38	23
4.00	0	0	0	0	0	1	1	1	1	1	1	2	2	2	3	3	4	5	9	19	63	217	52	25

TIME OF CONCENTRATION = 0.75 hours
Hydrograph time in hours

T_a	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	15	29	57	58	163	248	329	375	368	359	325	276	232	195	165	142	107	76	51	39	33	26	19	15
0.25	12	21	29	39	61	100	158	227	291	336	355	348	321	285	247	212	156	103	62	44	36	27	19	15
0.50	10	16	21	24	29	41	63	100	150	208	263	305	327	329	314	288	226	147	79	52	40	29	20	16
0.75	8	13	16	18	20	24	30	43	65	98	142	192	239	278	303	311	286	208	107	63	45	31	21	16
1.00	6	10	13	14	15	17	20	24	31	44	65	95	134	177	220	256	294	264	149	81	53	33	21	16
1.50	4	6	8	9	10	11	12	13	14	16	19	23	31	42	60	83	147	269	248	152	85	40	23	17
2.00	2	4	5	5	6	7	7	8	9	10	11	12	14	16	18	23	39	97	251	235	153	56	26	19
2.50	1	2	3	3	4	4	4	5	5	6	7	7	8	9	10	11	15	28	107	218	236	91	29	20
3.00	0	1	1	2	2	2	2	3	3	4	4	5	5	6	6	7	8	12	33	113	225	153	34	22
3.50	0	0	1	1	1	1	1	1	2	2	2	3	3	3	4	4	5	7	13	39	117	215	44	24
4.00	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	3	4	7	15	45	207	63	26

EARL RESERVOIR
TOWN OF WOODBURY

5-9

EXHIBIT G 3

PEAK DISCHARGE CALCULATIONS (BY TABULAR METHOD - EXHIBIT G)

SUB-AREA	T_c	T_T	D.A.	RAIN	CN	R.O.	HOUR 110	115	11.7'	118	119	120	121	122	123	124	125	126	127	128	129	130	(ESTIMATED) 111	113	115	117	116
1	0.4	0.1	0.172	7.20"	70	3.79	12	23	50	102	189	269	314	298	262	218	173	138	109	88	73	62					
2	0.4	0.1	0.167	"	70	3.79	11	22	48	99	183	261	305	289	254	211	167	133	105	85	70	60					
3	0.75	—	0.225	"	70	3.79	12	24	48	83	138	211	281	320	331	314	277	235	197	166	140	121					
4	0.3	—	0.031	"	71.8	3.97	2	5	17	39	72	81	66	46	31	22	18	15	12	10	9	8					
5	0.3	—	0.039	"	70	3.79	3	6	21	49	90	102	83	58	39	27	22	18	15	12	11	10					
6	0.5	—	0.091	"	77.8	4.64	7	15	33	70	127	183	209	200	167	130	102	81	66	56	46	39					
							47	95	217	442	799	1107	1258	1211	1084	922	759	610	504	415	349	300	55	64	74	84	185

Q_{100} (PEAK) = 1258 C.F.S.

EARL RESERVOIR
TOWN OF WOODBURY

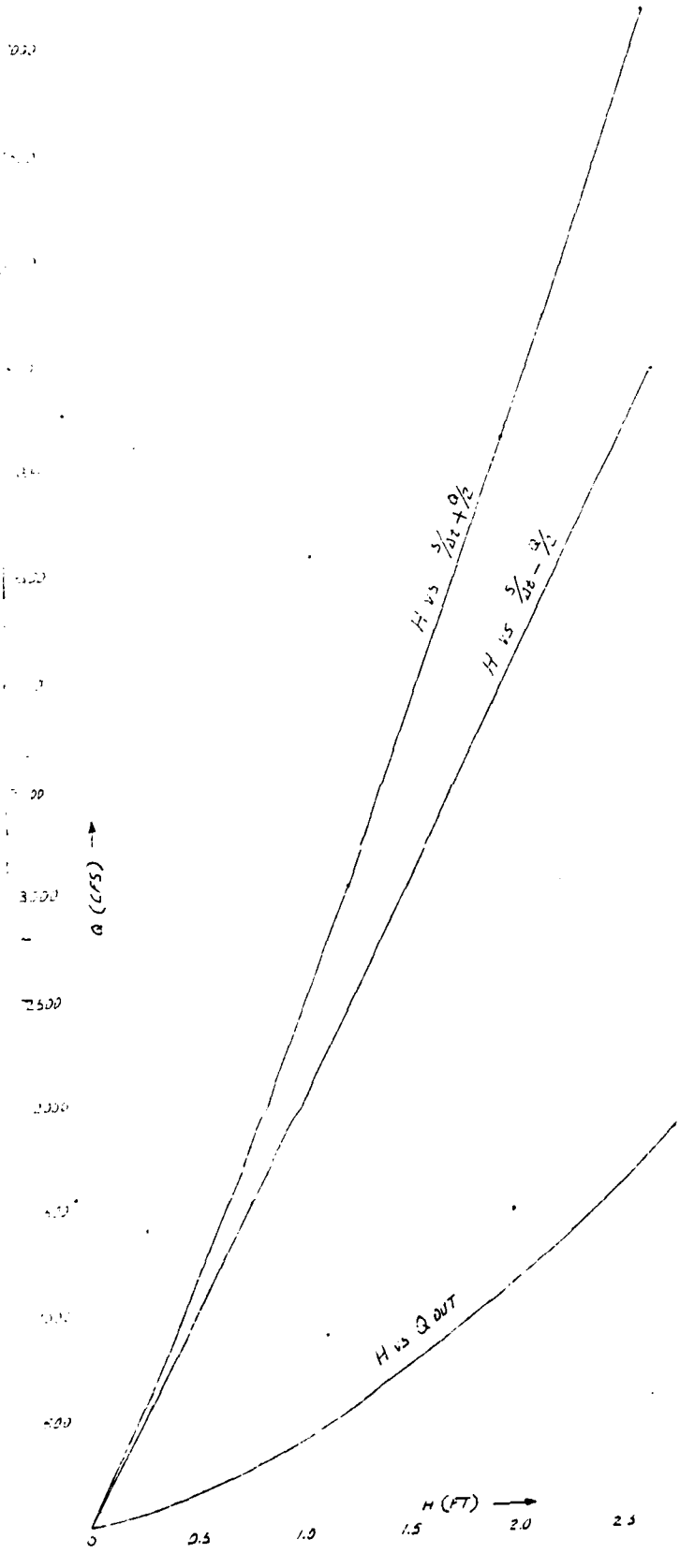


EXHIBIT J

EARL RESERVOIR
TOWN OF WOODBURY

EXHIBIT H

weirs of this type, each 4.9 ft high, were performed by the U.S. Deep Waterways Board.

Coefficients covering the range of Bazin's experiments are given in Table 5-9. Table 5-10 gives coefficients resulting from the experiments by the U.S. Deep Waterways Board.

TYPICAL →

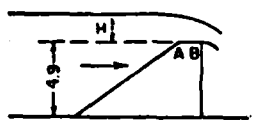


FIG. 5-10. Trapezoidal weir.

For weirs of trapezoidal cross section with sloping upstream and vertical downstream face (Fig. 5-10) there are five series of experiments by the U.S. Deep Waterways Board. All the models for these experiments were approximately 4.9 ft high, and the breadth of crest AB was either 0.33 or 0.66 ft. The length of all weirs was 6.58 ft. Table 5-11 gives coefficients derived from these experiments.

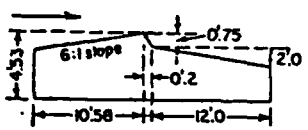


FIG. 5-11

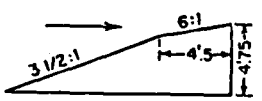


FIG. 5-12

Weirs of Irregular Section. Figures 5-11 to 5-15 represent models of weirs experimented on by the U.S. Deep Waterways Board, under the direction of G. W. Rafter, at the hydraulic laboratory of Cornell University. From four to seven experiments were run on each model, the range of head varying approximately from 1 to 5.5 ft. Values of C tabulated from these experiments are given in Table 5-12.

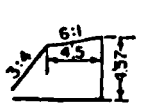


FIG. 5-13

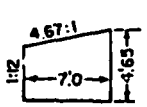


FIG. 5-14

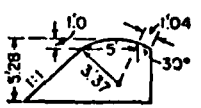


FIG. 5-15

Experiments for the U.S. Geological Survey, under the direction of Robert E. Horton, were performed in 1903 at the hydraulic laboratory of Cornell University to determine the coefficients of discharge of weirs modeled after various types

of dams. Figures 5-16 to 5-25 show forms of crests of models experimented on. The weirs were all 11.25 ft high and either 8 or 15 ft long. The purpose of the experiments was to enable the Geological Survey to determine more accurately discharges

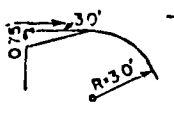


FIG. 5-16

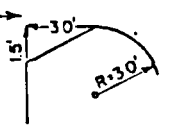


FIG. 5-17

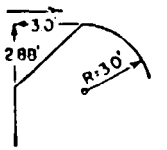


FIG. 5-18

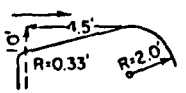


FIG. 5-19

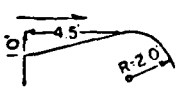


FIG. 5-20

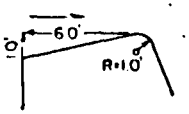


FIG. 5-21

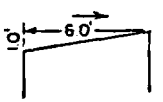


FIG. 5-22

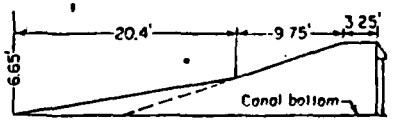


FIG. 5-23

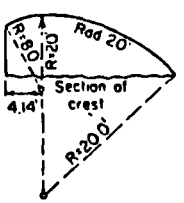


FIG. 5-24

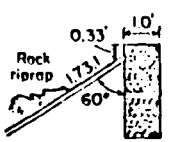


FIG. 5-25

over weirs at gaging stations. Coefficients obtained from these experiments are given in Table 5-13.

Figure 5-24 is a cross section of the old dam at Austin, Tex. Five series of gagings of flow over this dam were made with a current meter by Taylor[1] in 1900. The range of head was from 0.42 to 1.44 ft.

[1] T. U. Taylor, The Austin Dam, *U.S. Geol. Survey Water Supply and Irrigation Paper* 40, 1900.

EARL RESERVOIR
TOWN OF WOODBURY

...BORING DATA

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

453 East Route 211, Middletown, NY 10940

September 28, 1977

Mr. Ronald Rothenberg
Raimondi Associates PC
110 Stage Road
Monroe, NY 10950

RE: Earles' Reservoir, Town of Woodbury

Dear Mr. Rothenberg:

Our Area Engineering Support Staff in Newburgh, New York, has checked your computations, of the Earles' Reservoir dam and spillway capacities, for a 100 year storm event. They saw no problem with your computations.

Sincerely,

Malcolm Henning
District Conservationist

cc: J. ...elder

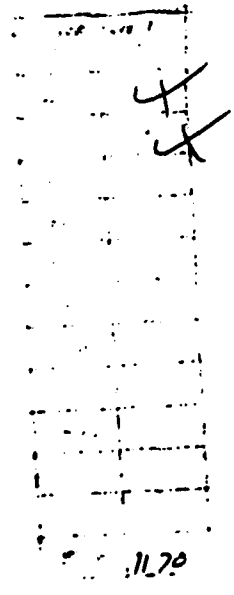


EXHIBIT S

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NO. W-1

Project Earl's Lake — Location Woodbury, N.Y.

Borings made by: A.Ecka — Archt. Engr. A.G.Lichtenstein — Date Started 9/21 — Completed 9/27

El. of Ground Water — Raimondi Assoc. — Length of Casing Driven

Ground Line Elevation Lake Surface

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
5		Water				
10						
15		15'				
	2	Mud & Clay				
	5					
	5	18'				
	12	F/M Gray Sand,				
20	18	Silty Clay &	1	22	25	33
	24	Gravel				
	29					
	76	23'				
	132					
	300	Brn. Clayey Silt,				
25	239	little fine Sand	2	50	71	75
	300	& Gravel				
	300+					
	300+					
			3	29	31	46
30		31'				58
		Bottom of boring				
35						
40						
45						

Inside Dia. of Casing 2½"
" " " Spoon 1⅜"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	21'6"	18"	
2 *	26'6	"	
3 *	31'0	24"	

* Used 300# Hammer to drive Spoon.

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

EXHIBIT T-1

EARL RESERVOIR
TOWN OF WOODBURY

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST BORING DATA

TEST HOLE NO. W-2

Project Earl's Lake Woodbury, N. Y. Location

Borings made by: A. Ecke Archt. Engr. A.G.Lichtenstein Raimondi Assoc. Date Started 9/22 Completed 9/22/77

El. of Ground Water Lake Surface Length of Casing Driven 30'

Ground Line Elevation

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
5		Water				
10						
		14'				
15	29	F/C Gray Sand,				
	240	Silty Clay, gravel				
	57	& Boulders				
	69					
	114					
	121					
20	85		1	32	22	24
	72	21'				
	77	Brn. Silt, some				
	112	23' fine sand & gravel				
	105					
25	79	Red-brn. Silt,	2	21	18	20
	92	trc. fine sand				
	121	& gravel				
	137					
	145	30'				
30		Red-brn. Silt &	3	69	100+	
		31'6" Sandstone			100+	
		Bottom of boring				
35						
40						
45						
50						

Inside Dia. of Casing 2½"
" " " Spoon 1⅜"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1 *	21'6"	18"	
2 *	26'6	"	
3 *	31'6	"	

* Used 300# Hammer to drive Spoon

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

EXHIBIT T-2

EARL RESERVOIR
TOWN OF WOODBURY

DO NOT WRITE ON BACK OF SHEET

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NO. W-3

Project Earl's Lake — Location Woodbury, N.Y

Borings made by: A. Ecke — Archt. Engr. A.G.Lichtenstein Raimondi Assoc. — Date Started 9/21 — Completed 9/21/77

Depth of Ground Water — Length of Casing Driven

Ground Line Elevation Lake Surface

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
	1	3'6" Water				
5	1	Mud				
	1	6'0				
	1	Gray Silty Clay,				
	3	little fine sand				
	4					
10	4					
	8	11'	1	3	4	14
	13	Gray Silty Clay,				
	10	little to some fine				
	34	sand				
	7					
15	6	16'	2	1	2	2
	7	17' Black Organic Silt				
	6	Gray Silty Clay				
	8	19' trc. sand				
	18					
20	48	Brn. Silt, little	3	23	62	24
	79	fine sand & gravel				
	138					
	235	24'				
	300+					
25		Brn. Silt,	4	28	130	
					100+	
		28'				
30						
		Chopped to 27'6"				
		Drove rod to 28'				
35						
40						
45						

Inside Dia. of Casing	2½"
" " " Spoon	1⅜"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	11'6	18"	
2	16'6	"	
3	21'6	"	
4 *	26'6	"	
* Used 300# Hammer			

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

EXHIBIT T-3

EARL RESERVOIR
TOWN OF WOODBURY

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NO. W-4

Project Earl's Lake Location Woodbury, N.Y.

Borings made by: A.Ecke Archt. Engr. A.G.Lichtenstein Raimondi Assoc. Date Started 9/22 Completed 9/22/77

El. of Ground Water Length of Casing Driven

Ground Line Elevation Lake Surface

Blows per Foot of Casing Penetration

Depth in Feet

Sample Number

Blows on Spoon (0/6, 6/12, 12/18)

Materials Encountered

Water

5'

F/M Gray Sand, Silty Clay, some Gravel

14'

Brn. Clayey Silt, little fine Sand & Gravel (Boulder at 17')

30'

31'6" Brn. Silt, trc. Sandstone

Bottom of boring

Casing Bent at 17-18'
Unable to drive casing below 20' Washed & Chopped to 30'0

Depth	Blows per Foot	Sample No.	Blows on Spoon (0/6, 6/12, 12/18)
5	3 4 4 6		
10	14 7 19 38 49	1	4 8 15
15	54 10 300* 28 56 14	2	19 24 42
20		3	No Rec.
	C H O P P E D	3	32 34 39
30		4	70 88 65
35			
40			
45			
50			

Inside Dia. of Casing 2½"
" " " Spoon 1⅜"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	11'6	18"	
2	16'6	"	
3	23'6	"	
4 *	31'6	"	

* Used 300# Hammer on Spoon

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

EXHIBIT T-4

EARL RESERVOIR
TOWN OF WOODBURY

DO NOT WRITE ON BACK OF SHEET

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NOL-5

Project Earl's Lake — Location Woodbury, NY.

Borings made by: A. Ecke — Archt. Engr. A.G. Lichtenstein / Raimondi Assoc. — Date Started 8/31 — Completed 9/1/77

El. of Ground Water — Length of Casing Driven

Ground Line Elevation

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon (0/6, 6/12, 12/18)
0	4	Materials Encountered		
	4	Fill, Silt, Clay		
	6	Gravel, Boulders		
	16			
5	23	5'		
	29		1	10 27 42
	47	Gray Clayey Silt,		
	158	gravel, boulders,		
	73	little Sand		
	69			
10	63		2	28 37 44
	97			
	158			
	182			
	197			
15	149	15'	3	25 24 21
	89	Gray Clayey Silt,		
	117			
	135	little fine sand		
	185			
20	145	Trc. fine gravel	4	35 48 56
	157			
	151			
	162			
	318			
25		26'6"	5	35 40 50+
		Bottom of boring		
30				
35				
40				
45				

Inside Dia. of Casing	2½"
" " " Spoon	1⅜"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	6'6"	18"	
2	11'6	"	
3 *	16'6	"	
4 *	21'6	"	
5 *	26'6	"	

* Used 300# Hammer

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

EXHIBIT T-5

EARL RESERVOIR
TOWN OF WOODBURY

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NO. L-6

Project Earl's Lake — Location Woodbury, NY

Borings made by: A.Ecke — Archt. Engr. A.G.Lichtenstein Raimondi Assoc. — Date Started 8/31 — Completed 8/31/77

Fl. of Ground Water — Length of Casing Driven

Ground Line Elevation

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
	4	Materials Encountered				
	21					
	28	Fill, Silt, Sand,				
	7	Gravel				
	15	5'				
5	10		1	6	11	8
	8	Brn. Clayey Silt,				
	10	some Sand & Gravel				
	31	9' Possible Fill				
	58					
10	23	Gray Clayey Silt	2	63	32	30
	37	12' F/c Sand & Gravel				
	49					
	85	Brn. Silt,				
	59					
15	61	trc. fine Sand	3	38	59	56
	83					
	237	trc. fine Gravel				
	276					
	300+					
20		20'6"	4	100+		
		Bottom of boring				
25						
30						
35						
40						
45						

Inside Dia. of Casing	2½"
" " " Spoon	1⅜"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	6'6"	18"	
2	11'6	"	
3	16'6	"	
4 *	20'6	6"	

* Used 300# Hammer

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

EXHIBIT T-6

EARL RESERVOIR
TOWN OF WOODBURY

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NO. L-7

Project Earl's Lake — Location Woodbury, NY

Borings made by: A.Ecke — Archt. Engr. A.G.Lichtenstein Raimondi Assoc. — Date Started 9/23 — Completed 9/23/77

Fl. of Ground Water 1'6" below grade — Length of Casing Driven 25'0

Ground Line Elevation

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
5	4 3 4 5 7	Gray Silty Clay, some Gravel	1	3	5	4
10	3 5 10 29 43	10'	2	13	18	20
15	47 58 62 60 77	Brn. Silty Clay, some gravel, little fine sand — 15'	3	22	19	23
20	52 57 59 70 103	Red-Brn. Silt, trc. fine sand, trc. fine gravel	4	23	21	24
25	71 87 119 231 300+	26'6" Bottom of boring	5	90	103	100+
30						
35						
40						
45						

Inside Dia. of Casing 2½"
" " " Spoon 1⅜"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	6'6"	18"	
2	11'6	"	
3 *	16'6	"	
4 *	21'6	"	
5 *	26'6	"	

* Used 300# Hammer

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

EXHIBIT T-7

EARL RESERVOIR
TOWN OF WOODBURY

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

EST HOLE NO. L-8

Project Earl's Lake — Location Woodbury, N.Y.

Borings made by: A. Ecke — Archt. Engr. A.G. Lichtenstein Raimondi Assoc. — Date Started 9/1 — Completed 9/1/77

Fl. of Ground Water — Length of Casing Driven

Ground Line Elevation

Depth in Feet | Blows Per Foot of Casing Penetration | Sample Number | Blows on Spoon (0/6, 6/12, 12/18)

Depth	Blows/Ft	Sample	0/6	6/12	12/18
	34				
	58				
	67				
	24				
	52				
5	81	1	46	58	65
	76				
	67				
	73				
	89				
10	79	2	29	58	50
	163				
	182				
	97				
	89				
15	83	3	42	48	45
	97				
	153				
	227				
	473				
20		4	84	53	90
25		5	100+		100+
30					
35					
40					
45					

Materials Encountered — Fill

3' Silt, Sand, Gravel

Brn. Clayey Silt, some C/F Sand & Gravel Boulders

15' Red-Brn. Silt, trc. fine Sand trc. fine gravel

26' Bottom of boring

Chopped & Washed from 20' to 25'0

Inside Dia. of Casing	2½"
" " " Spoon	1⅜"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	6 6"	18"	
2	11'6	"	
3	16'6	"	
4 *	21'6	"	
5 *	26'0	12"	

* Used 300# Hammer

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

EXHIBIT T-8

EARL RESERVOIR
TOWN OF WOODBURY

TEST BORING DATA

W. M. WALSH COMPANY, INC.
Cresskill, New Jersey

TEST HOLE NO. L-9

Project Earl's Lake — Location Woodbury, NY

Borings made by: A. Ecke — Archt. Eng. A. G. Lichtenstein Raimondi Assoc. — Date Started 9/1 — Completed 9/2/77

El. of Ground Water — Length of Casing Driven

Ground Line Elevation

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
5	25 70 52 73 69 38	Brn. Clayey Sillt some fine Sand, Gravel, Boulders	1	47	38	29
10	42 97 90 76 68 57		2	29	48	33
15	79 55 48 73	15'	3	31	62	110
20	85 141 189 276 75 71	Red-Brn. Silt trc. fine Sand trc. fine gravel	4	84	100+	
25	73 300 300	23' Brn. Silt & Rock Fragments trc. fine sand	5	150+		
30		30' 31' Silt & Broken Rock Bottom of boring	6	60	100+	
35						
40						
45						

Inside Dia. of Casing	2½"
" " " Spoon	1⅜"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	6'6"	18"	
2	11'6	"	
3	16'6	"	
4 *	21'0	12"	
5 *	25'6	6"	
6 *	31'0	12"	
* Used 300# Hammer			

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

EXHIBIT T-9

EARL RESERVOIR
TOWN OF WOODBURY

APPENDIX F

BACKGROUND DOCUMENTS

W. M. IMBRIE, PRESIDENT
MARVYN SCUDDER, TREASURER

COMMONWEALTH WATER COMPANY OF NEW YORK
46 BROADWAY, NEW YORK

October 17, 1912.

Mr. Alexander Rice MaKim, C. E.,
New York Conservation Committee,
Albany, N. Y.

Dear Sir:

Your telegram of Tuesday unfortunately reached me too late to allow my being able to meet you at 8'45 yesterday morning at Highland Mills. I instructed my assistant engineer, however, to show you every courtesy and expedite as far as possible any investigation or inspection which you might wish to make, and I trust that this was done.

A rather meagre telephone message this morning informed me that you visited the site and inspected the trench which is being put in for the foundation.

I was also informed that you deemed it necessary to carry the footings of the extreme easterly wing of the dam down about five feet and that you further thought it would be necessary to go fifteen or twenty feet in depth at the center, that is, under the heaviest portion of the dam, unless rock should be encountered at a higher level.

These views coincide entirely with my own and I feel that the footings should be carried to the levels suggested by you, unless indeed rock is encountered. Personally I feel that rock will be encountered at a higher level under

the deeper portion of the dam.

The soundings taken by us across the Valley showed rock at about the level shown on the plans, or rather on sections, but the formation is so treacherous and the ground so larded with broken bowlder formation that it is more than possible that some of our soundings reached bowlder rather than ledge rock; in fact the trench as open to date seems to indicate this.

My feeling is that if we go to the depths suggested by you and concurred in by me and find at those levels a very heavy dense clay which would seem impervious to water action we would be abundently safe in establishing such levels for our lower footings.

I would be extremely obliged to you, when writing me on the subject, if you will be as full as possible as you have time. Of course, I realize that you are a very busy man, and have many demands upon your time, but I want you to feel that it is the desire of the Company, as well as its engineer, to embody and carry out your views as far as it is possible.

With kind personal regards, I am

Very truly yours,

W. F. Curtis

FST/F

Engineer

Woodbury Field + Stream Inc.

DAM INSPECTION REPORT
(By Visual Inspection)

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
453	L. Hudson	Woodbury	Orange	A	6-14-74 GVE-KDH

Type of Construction

- ☐ Earth w/concrete spillway
- ☐ Earth w/drop inlet pipe
- ☐ Earth w/stone or riprap spillway
- ☐ Concrete
- ☑ Stone
- ☐ Timber

Use

- ☑ Water Supply
- ☐ Power
- ☑ Recreation
- ☐ Fish and Wildlife
- ☐ Farm Pond
- ☐ No Apparent Use-Abandoned

Estimated Impoundment Size

- ☐ 1-5 acres
- ☐ 5-10 acres
- ☑ Over 10 acres

Estimated Height of Dam above Streambed

- ☐ Under 10 feet
- ☐ 10-25 feet
- ☑ Over 25 feet

Condition of Spillway

- ☐ Service satisfactory
- ☑ In need of repair or maintenance
- ☐ Auxiliary satisfactory
- ☐ In need of repair or maintenance

Explain: Leakage thru stone

Condition of Non-Overflow Section

- ☐ Satisfactory
- ☑ In need of repair or maintenance Explain: Leakage thru stone

Condition of Mechanical Equipment

- ☐ Satisfactory
- ☐ In need of repair or maintenance Explain:

Evaluation (From Visual Inspection)

- ☑ No defects observed beyond normal maintenance
- ☐ Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary

1974

EARL RESERVOIR

SHEET 3

Supplement D-1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK 12233

APPLICATION FOR PERMIT

FOR THE CONSTRUCTION, RECONSTRUCTION OR REPAIR OF A DAM OR OTHER IMPOUNDMENT STRUCTURE

Read instructions on reverse side of last sheet before completing this application. PLEASE TYPE OR PRINT CLEARLY IN INK

FOR DEPARTMENT USE ONLY
APPLICATION NO. 3-36-24-00551
DAM NO.
WATERSHED

PROJECT DESCRIPTION

1. LOCATION ON U.S. GEOLOGICAL SURVEY MAP — Name of Map: Monroe; Latitude: 41°-21'-48"; Longitude: 74°-08'-10"

2. PROPOSED USE FOR IMPOUNDED WATER: Recreation & Aux. Water Supply

3. STATE THE HEIGHT ABOVE SPILLCREST OF THE LOWEST PART OF THE IMMEDIATE UPSTREAM ADJOINING PROPERTY OR PROPERTIES: * All surrounding prop. Feet

4. IS THIS PROPOSED POND OR LAKE PART OF A PUBLIC WATER SUPPLY? [X] Yes [ ] No
If not, where is nearest downstream public water supply intake?

5. SIZE OF AREA DRAINING INTO POND OR LAKE (Acres or Square Miles): 464 Acres

HEIGHT OF DAM ABOVE STREAM BED? 28 (proposed) Feet

6. THE DRAINAGE AREA IS COMPOSED OF: (Total = 100%)

95 % Forest ____ % Cropland ____ % Pasture ____ % Other 4 % Swamp 1 % Suburban Lands ____ % Urban Lands

7. TYPE OF SPILLWAY
[ ] Service Spillway – Auxiliary Spillway Combination [ ] Pipe Riser ONLY [ ] Other
[X] Single Spillway w/ mud gate

8. DESIGNER'S ESTIMATE OF CLASS OF HAZARD (As described in "Guidelines for Small Earth Dam Designs")
[ ] Class "A" [X] Class "B" [ ] Class "C"
NOTE: Provide descriptive information on character of downstream area.

9a. SPILLWAY INFLOW DESIGN FLOOD 150% X 100 yr.*
Frequency * Flood Peak 1087 cfs Runoff Volume 5.86 in.

9b. SERVICE SPILLWAY INFLOW DESIGN FLOOD
Frequency ____ Flood Peak ____ cfs Runoff Volume ____ in.

10. THE SINGLE SPILLWAY OR AUXILIARY SPILLWAY IS COMPOSED OF:
[ ] Vegetated Earth [X] Concrete [ ] Timber [ ] Rock-filled Crib [ ] Masonry [ ] Other ____

11. MAXIMUM VELOCITY WITHIN THE SINGLE OR AUXILIARY SPILLWAY 25+ fps

12. SINGLE OR AUXILIARY SPILLWAY DISCHARGE AT DESIGN HIGH WATER 1392 cfs

13. TYPE OF ENERGY DISSIPATER PROVIDED ON SINGLE SPILLWAY
[ ] Hydraulic Jump Basin [X] Drop Structure [ ] Other ____

14. POND OR LAKE WILL BE DRAINED BY MEANS OF: 20" mudgate

WATER WILL BE SUPPLIED TO RIPARIAN OWNERS DOWNSTREAM BY MEANS OF: normal overflow

15. AREA-CAPACITY DATA — Answer 1, 2 and 3, OR 1, 2, 4, 5

	ELEVATION, Referred to Assumed Benchmark	SURFACE AREA	VOLUME STORED
1. Top of Dam	832 Feet	21.50 Acres	72.81 Acre-Feet
2. Design High Water	830.65 Feet	20.02 Acres	44.82 Acre-Feet
3. Single Spillway Crest	828.00 Feet	16.0 Acres	*150+- Acre-Feet
4. Auxiliary Spillway Crest	____ Feet	____ Acres	____ Acre-Feet
5. Service Spillway Crest	____ Feet	____ Acres	____ Acre-Feet

16. TYPE OF ENERGY DISSIPATER AT OUTLET OF CONDUIT:
[ ] Impact Basin [ ] Hydraulic Jump Basin
[X] Plunge Pool [ ] Other ____

IS PIPE RISER PROVIDED WITH AN ANTI-VORTEX DEVICE?
[ ] Yes [X] No

17. DRAWDOWN TIMES: Answer 1 and 2, OR 1, 3 and 4* See attached Engineer's report.

	Yes	No
1. Has provision been made to evacuate 90% of the storage below the lowest spillway crest within fourteen days?	[X]	[ ]
2. Can the single spillway evacuate 75% of the storage between the maximum design high water and the spillway crest within 48 hours?	[X]	[ ]
3. Can the Service Spillway evacuate 75% of the storage between the auxiliary spillway and the Service Spillway crest within seven days?	[ ]	[ ]
4. Can the Service Spillway and the Auxiliary Spillway in combination evacuate the storage between the design high water and the auxiliary spillway crest within 12 hours?	[ ]	[ ]

18. SOIL DATA – State the character of the bed and banks in respect to natural types of soil materials, hardness, perviousness, water bearing, effect of exposure to air and water, uniformity, etc.

See Boring logs

If an earth dam, describe the material to be used in the embankment.

See Specifications

What is the source of embankment fill material(s)?

Contractors option

*erties owned by APPLICANT

Are there porous seams or fissures beneath the foundation of the proposed dam? [ ] Yes [X] No

Method used to obtain the above soil data: [X] Soil Borings [ ] Test Pits

19. DESIGN ENGINEER
Name of Agency or Individual: A.G. Lichtenstein & Ass. | P.E. License No. of Individual: 28337
Address: 1258 Teaneck Road, Teaneck, N.J. 07666
Title: --sident | Telephone No.: 201-837-4300

20. CONSTRUCTION ENGINEER
Name of Agency or Individual: Raimondi Assoc. P.C. | P.E. License No. of Individual: 40,212
Address: 110 Stage Road, Monroe, N.Y. 10950
Title: President | Telephone No.: 914-782-8681

93-19-2 (2/77)

STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK 12233

APPLICATION FOR PERMIT

APPLICATION NO.

☐ Article 15 (STREAM PROTECTION) Environmental Conservation Law
- ☑ For the construction, reconstruction or repair of a DAM or other impoundment structure.
- ☐ For the construction, reconstruction or repair of any permanent DOCK, pier or wharf; and any dock, pier or wharf, built on open work supports, which has a top surface area of more than 200 square feet.
- ☐ For the disturbance of a STREAM BED or excavation in or fill of navigable waters.

☐ Article 24 (FRESHWATER WETLANDS) Environmental Conservation Law

☐ Article 25 (TIDAL WETLANDS) Environmental Conservation Law

Read instructions on reverse side of last sheet before completing this application. PLEASE TYPE OR PRINT CLEARLY IN INK.

1. NAME AND ADDRESS OF APPLICANT
First / M.I. / Last: Town of Woodbury
TELEPHONE NO.: 914-928-6829
Street Address: Albany Turnpike (Route 32) Highland Mills, N.Y.
Post Office / State / Zip Code: 10930

2. NAME AND ADDRESS OF OWNER (If different from Applicant)
First / M.I. / Last:
Street Address:
Post Office / State / Zip Code:

3. AGENCY SUBMITTING APPLICATION: ParkCoormission

PROJECT DATA

4. LOCATION OF WETLAND OR ADJACENT AREA, STREAM, OR BODY OF WATER
Body of Water: Earl Reservoir
Town: Woodbury
County: Monroe
Locate by giving distance and direction from a commonly accepted and identifiable landmark or body of water or U.S.G.S. coordinates.

5. SIZE OF WORK SECTION: 500' +

6. SPECIFIC LOCATION: D.E.C. Designation H-89-7-6-P229a

7. WILL PROJECT UTILIZE STATE OWNED LANDS? ☐ Yes ☒ No

8. TYPE AND EXTENT OF WORK (Feet of new channel; yards of material to be removed, draining, dredging, filling, etc.)
Reconstruction of Dam

9. DOES PROJECT COMPLY WITH
A. Use Guidelines (If any): N.A.
B. Development Restrictions (If any):

10. PURPOSE (Hardship)
Emergency/dam repair & municipal recreation

11. IF A DAM OR OBSTRUCTION, INDICATE
Height 28 Size of Pond 16 + Acres

12. PROPOSED STARTING DATE: June 1, 1978

13. APPROXIMATE COMPLETION DATE: Nov. 1, 1978

14. NAME AND ADDRESS OF TWO OFFICIAL NEWSPAPERS IN LOCALITY WHERE PROPOSED ACTIVITY IS LOCATED
Times Herald Record
1 Stage Road
Monroe, New York 10950

Photo News
Warwick, N.Y.

15. CERTIFICATION
I hereby affirm under penalty of perjury that information provided on this form and all attachments submitted herewith is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law. As a condition to the issuance of a permit, the applicant accepts full legal responsibility for all damage, direct or indirect, of whatever nature, and by whomever suffered, arising out of the project described herein and agrees to indemnify and save harmless the State from suits, actions, damages and costs of every name and description resulting from the said project.

DATE / SIGNATURE

95-19-2 (2/77)

– SEE REVERSE SIDE –

END

DATE
FILMED
11-81

DTIC